ESHCRU Economics of Social and Health Care Research Unit

CHE Centre For Health Economics

University of York

Productivity of the English NHS: 2013/14 Update

Chris Bojke, Adriana Castelli, Katja Grašič, Daniel Howdon, Andrew Street

CHE Research Paper 126

Productivity of the English NHS: 2013/14 update

Chris Bojke
Adriana Castelli
Katja Grašič
Daniel Howdon
Andrew Street

Centre for Health Economics, University of York, York, UK

January 2016

Background to series

CHE Discussion Papers (DPs) began publication in 1983 as a means of making current research material more widely available to health economists and other potential users. So as to speed up the dissemination process, papers were originally published by CHE and distributed by post to a worldwide readership.

The CHE Research Paper series takes over that function and provides access to current research output via web-based publication, although hard copy will continue to be available (but subject to charge).

Acknowledgements

We thank John Bates, Keith Derbyshire, Caroline Lee and Shelley Lowe for their assistance. This is an independent study commissioned and funded by the Department of Health in England as part of a programme of policy research at the Centre for Health Economics (070/0081 Productivity; 103/0001 ESHCRU). The views expressed are those of the authors and not necessarily those of the Department of Health. The Hospital Episode Statistics are copyright © 2004/05 - 2013/14, re-used with the permission of The Health & Social Care Information Centre. All rights reserved.

Further copies

Copies of this paper are freely available to download from the CHE website www.york.ac.uk/che/publications/ Access to downloaded material is provided on the understanding that it is intended for personal use. Copies of downloaded papers may be distributed to third-parties subject to the proviso that the CHE publication source is properly acknowledged and that such distribution is not subject to any payment.

Printed copies are available on request at a charge of £5.00 per copy. Please contact the CHE Publications Office, email che-pub@york.ac.uk, telephone 01904 321405 for further details.

Centre for Health Economics
Alcuin College
University of York
York, UK
www.york.ac.uk/che

Executive summary

The issue of NHS productivity currently holds substantial public attention, particularly given the efficiency challenge set out in the Five Year Forward View published by NHS England and other national bodies 2014. In 2015 the Department of Health appointed a Minister (Parliamentary under Secretary of State) with a specific ministerial brief for NHS productivity.

This report is the latest in a regular series of NHS productivity measures produced by the Centre for Health Economics. This report updates the time-series of National Health Service (NHS) productivity to account for growth between 2012/13 and 2013/14. NHS output encompasses all activity, as valued by administrative costs, for NHS patients, and is measured by combining data from Reference Costs, Hospital Episode Statistics, Prescription Cost Analysis, and the GP Patient Survey.

NHS inputs are made up of labour, intermediates and capital, used by the NHS in carrying out its activity for the financial year. We calculate input growth using data from organisational accounts and from workforce data.

Productivity growth is positive when the rate of growth of outputs exceeds that of inputs – as we again observe here for the most recent financial year – and negative when the opposite is true.

Output growth is measured at 2.64% for the NHS as a whole, with improvements in quality accounting for 0.27% of this growth. These rates represent an increase on the previous year's output growth of 2.34% – the lowest recorded since our series began in 2004/5 – and a return to a positive quality adjustment. Quality improvements include reductions in waiting times and improvements in HRG-level survival rates following discharge from hospitals. Output growth is broadly within the range observed over the last four years, and is driven mainly by growth in non-admitted activity as captured by Reference Cost data.

We find that overall NHS input growth is low, at around 0.55%, and down from 2.36% on the previous year. This is mainly due to replacement of Primary Care Trusts by Clinical Commissioning Groups, following the 2012 Health & Social Care Act.

Productivity growth between 2012/13 and 2013/14 for the NHS was 2.07%. This represents a substantial rise on the 0.36% estimate recorded for the previous financial year, and is the fourth consecutive period of positive year-on-year productivity growth.

Glossary of acronyms

A&E	Accident & Emergency
AD	Admitted
ALB	Arm's Length Body
CCG	Clinical Commissioning Group
CDEL	Capital Departmental Expenditure Limit
CIPS	Continuous Inpatient Spell
CQC	Care Quality Commission
CSU	Commissioning Support Unit
DH	Department of Health
ESR	Electronic Staff Record
FCE	Finished Consultant Episode
FTE	Full-time Equivalent
H&SC Act	Health & Social Care Act 2012
HES	Hospital Episode Statistics
HRG(4/4+)	Healthcare Resource Group (version 4/4+)
HSCIC	Health and Social Care Information Centre
ISHP	Independent Sector Health Care Provider
MH	Mental Health
MSG	Major Staff Group
NAD	Not admitted
NHS	National Health Service
ONS	Office for National Statistics
PCA	Prescription Cost Analysis
PCT	Primary Care Trust
PSSRU	Personal & Social Services Research Unit
QOF	Quality and Outcomes Framework
RC	Reference Costs
RDEL	Revenue Departmental Expenditure Limit
RDNA	Regular Day and Night Attendance
SHA	Strategic Health Authority
SUS	Secondary Uses Service
TDEL	Total Departmental Expenditure Limit
TFR	Trust Financial Returns

Contents

1. Introduction

In this report we calculate growth in NHS productivity between 2012/13 and 2013/14, thereby extending our series that provides estimates of growth from 1998/99 onwards. The series was first published in 2004/05.

Arguably, interest in NHS productivity has never been higher. The publication of the Five Year Forward View by NHS England presents the view that despite a budget for the NHS of approximately £110bn per annum (DH Annual Report and Accounts 2013-14), increasing demand created by an ageing population and changes in public expectation means that the NHS could struggle to meet the healthcare needs of the population it serves: it is estimated that without an even greater increase in real inputs or further efficiency savings, the NHS will face a funding gap of some £30bn by 2020/21[1]. Subsequent commitments to additional financing would in effect narrow this gap to £22bn.

We have previously calculated that, prior to 2013/14, growth in the English NHS's productivity has been consistently positive over 3 pairs of years – an unprecedented run of positive productivity growth (Bojke et al., 2015). We have attributed this result to a sustained period of restrained input growth (in particular, labour input growth). Output growth in recent years has also been below earlier trends, but has not fallen as far as input growth below its respective trend.

The financial year 2013/14 not only represents the fifth year of the longest period of austerity the NHS has known, the third year of the original four year 'Nicolson Challenge'[2], but also the first year in which the NHS reforms established by the Health & Social Care Act 2012 (H&SC Act) came into force. The H&SC Act may have had two important impacts on productivity. Firstly, it may have directly affected the productivity of the NHS itself. But secondly, and perhaps less obviously, the large scale reorganisation may also have impacted on the collection and coverage of the large-scale routine datasets used to measure the inputs and outputs of the NHS. For example, although PCTs existed until the end of the 2012/13 financial year, they were not required to contribute to 2012/13 Reference Costs. This means that there is some risk that aspects of both inputs and outputs may not have been captured in a consistent way across the two years.

Similarly, it is not clear to what extent many of the new organisations (such as the newly created Clinical Commissioning Groups (CCGs)) have fully contributed to both input and output data sources. For example only 70% of CCGs provide centralised labour force data and none provide output data to Reference Costs, although it is clear from other sources, such as the Hospital Episode Statistics, that CCGs provide at least some outpatient activity. This means that the ability to calculate growth across the whole NHS is somewhat compromised.

The other major change between 2012/13 and 2013/14 that might impact on productivity is the consequence of the publication of various reports, all of which made staffing recommendations: the Francis Inquiry (Francis R. (Chair), 2010), the Keogh Review (Keogh, 2013), the Berwick Review (Berwick, 2013) and the new regulatory regime for the Care Quality Commission (CQC). All these reviews suggested that there were quality and safety consequences to understaffing or inappropriate staffing mixes. These reports are argued to have led to a recruitment drive and increase in staffing in the latter half of 2013/14 (Appleby J. et al, 2014).

As with our previous reports, we follow national accounting conventions to measure the change in productivity over time by means of a chained index (Eurostat, 2001). We concentrate on the calculation and comparison of output and inputs between 2012/13 and 2013/14. This latest 'link' is

[1] https://www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf
[2] More formally known as the Quality, Innovation, Productivity and Prevention (QIPP) programme

then attached to the chained index that reports productivity changes over the entire period from 2004/5.

The methods we adopt are unchanged from previous reports and so we relegate the detail of formulating the indices to a technical appendix, but provide a brief summary here. In our output calculations, we construct a Laspeyres volume growth index. In the continued absence of comprehensive health outcome data, we weight different types of NHS output using the previous year's cost for each specific output. We also quality-adjust the cost-weighted output to take into account changes in 30-day survival following discharge from hospital, waiting times, and improvements in blood pressure monitoring in primary care. Thus, all other things being equal, improved quality in these dimensions contributes to productivity growth.

Growth in the volume of inputs is calculated primarily using accounts data. Current spending on labour, capital and intermediate resources are deflated to last year's costs in order to facilitate a meaningful comparison of the volume of input use in the paired years. In the case of labour, a more direct measure is possible for the majority of organisations because information about the volume and costs of staff is available from the NHS Electronic Staff Record (ESR). This permits two alternative measures of input growth – one constructed entirely from deflated accounts data (the indirect measure) and one which uses indirect measures of capital and intermediates but the direct measure of labour growth where possible (the mixed measure of input growth). This allows us to assess how sensitive productivity growth is to how labour input is measured.

The focus of the report is on the data used to calculate output and input growth between 2012/13 and 2013/14. Specific details are provided about any potential artefacts that may compromise a genuine like-for-like comparison across the two years.

The structure of the report is as follows. In Section 2 we describe changes to the NHS that are likely to impact on productivity measurement over this period. The output index is populated in Section 3, and the elements of the input index are reported in Section 4. Section 5 reports the productivity growth figures. Summary and concluding remarks are provided in Section 6.

2. Organisational change in the NHS, money flows and productivity coverage

The H&SC Act 2012 introduced major changes to the underlying commissioning structure of the NHS. As Figure 1 shows, England's 10 Strategic Health Authorities (SHAs) and 152 Primary Care Trusts (PCTs) were abolished and their combined functions replaced by a new structure: NHS England, incorporating 4 Regional Offices, 27 Area Teams, 17 Commissioning Support Units (CSUs) and 211 Clinical Commissioning Groups (CCGs). In addition, the creation of new non-NHS Arm's Length Bodies (ALBs), such as Public Health England, has changed the overall role of the Department of Health (DH) itself. Changes to the provider landscape have been less marked. Between 2012/13 and 2013/14, only a small number of trusts merged, changed from NHS to Foundation Trusts, or were dissolved.

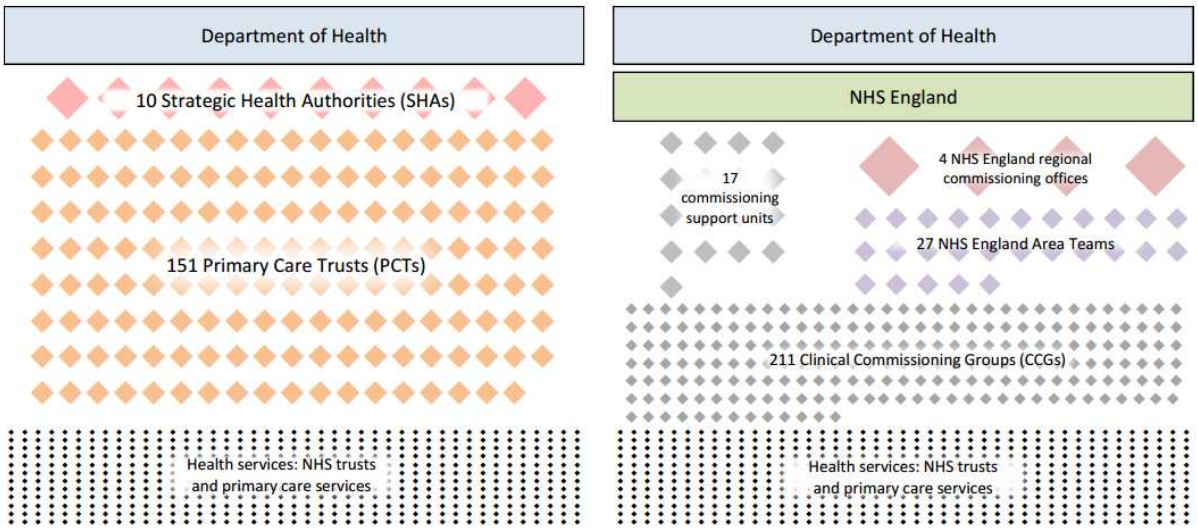


Figure 1 : Organisational change in the NHS

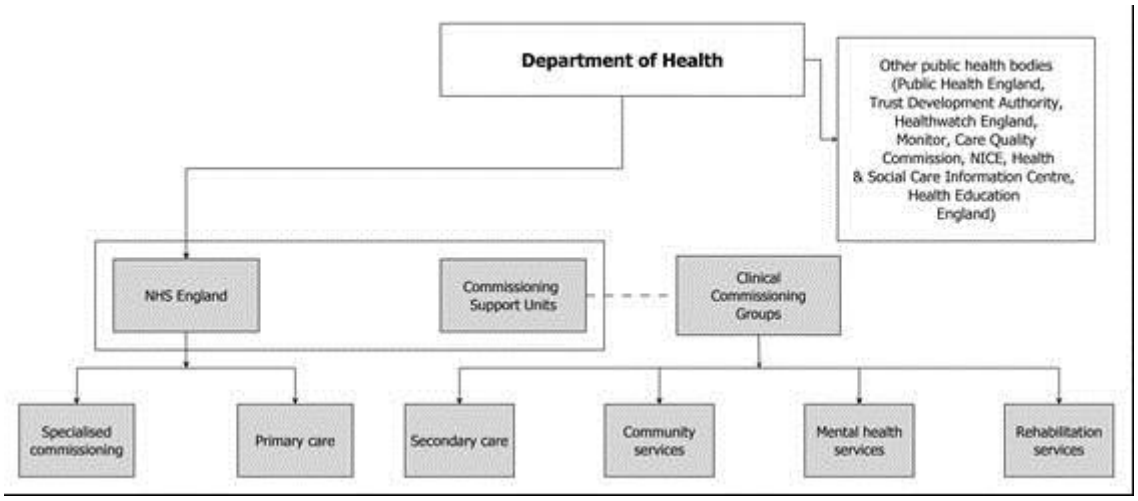


Figure 2 : Activity coverage in 2013/14

This organisational restructuring has consequences for defining the scope of the productivity measure: the objective of this report is to cover the growth of the inputs and outputs related to NHS England. A comparison of like-for-like which includes DH spending is problematic because it is not possible to attribute the distribution of DH input across its multiple functions with ALBs. As a result, the 2012/13 to 2013/14 productivity measure is limited to the organisations in Figure 1 below the DH or, equivalently, those in the shaded boxes in Figure 2.

Although we do not use top-line accounts data as our measures of inputs, it is useful to have a broad understanding of the revenue flows in order to place the productivity components and measures in context. According to national accounts, the DH had a Revenue Departmental Expenditure Limit (RDEL) outturn of £106bn in 2013/14 – an increase from £103bn in 2012/13. Of this, £95bn was allocated to NHS England. A further £4.3bn of DH Capital DEL was spent in 2013/14 compared to 3.8bn in 2012/13. This sums to a total DH spend of approximately £110bn in 2013/14, compared to £107bn in 2012/13 (DH Annual Report and Accounts 2013-14).

NHS England accounts (2014) report RDEL spend for the NHS England Group (NHS England plus CSUs and CCGs) of some £94.5bn for 2013/14. An equivalent top-line figure for 2012/13 is difficult to construct as there was no single organisation responsible for that slice of inputs below the DH, and hence no single definitive source of accounts data. However, DH annual accounts (2013) report a combined RDEL outrun of £98.8bn to SHA/PCTs and providers in 2012/13. The perceived drop in the RDEL spend between 2012/13 and 2013/14 is likely due to the reporting artifact resulting from the organisational changes in the NHS.

Approximately two-thirds of this budget is allocated (in 2013/14 to CCGs) for locally commissioned services such as: secondary care, community services, mental health services and rehabilitation services. The remaining third is spent by NHS England directly on running costs and nationally commissioned services including primary care and many specialised services. In 2012/13 approximately 80% was allocated to PCTs to cover primary and secondary healthcare purchases.

Some of the nationally commissioned services by NHS England are purchased from provider trusts, thus approximately 75% of its total budget is for secondary care expenditure. In 2013/14, some £10bn of this was in non-NHS organisations. DH account figures suggest that spending on primary care amounts to around 22% of TDEL expenditure.

3. Output

3.1 Measuring output

Our NHS output index is designed to capture all activities provided to NHS patients, whether by NHS or private sector organisations. Table 1 below summarises data sources used to measure activity, quality and costs, and also indicates specific measurement issues that have had to be tackled in constructing the output growth index for 2012/13 – 2013/14. The data and these specific issues are detailed in the remainder of this section. It should be noted that we have two alternative sources of volume of activity for outpatient output: the Hospital Episode Statistics (HES) outpatient dataset, and the Reference Costs database. We compare the outpatient activity in these datasets.

Table 1 Summary of output data sources

Output type	Activity source	Cost source	Quality	Notes for 2012/13 and 2013/14 data
Elective	HES	RC	30-day survival; health outcomes; waiting times	Activity described by HRG4+
Non-elective	HES	RC	30-day survival; health outcomes	Activity described by HRG4+
Outpatient	HES (or RC)	RC	Waiting times	Waiting time comes from HES Two sources of activity data
Mental health	HES & RC	RC	30-day survival; health outcomes; waiting times	Due to error in the reporting by one trust, the data used does not match the online Reference Cost data
Community care	RC	RC	N/A	
A&E	RC	RC	N/A	
Other (1)	RC	RC	N/A	
Primary care	Pre-2009/10 from QResearch Post-2009/10 from GP patient survey	PSSRU Unit Costs of Health and Social Care	QOF data	Uplift survey responses by population growth; changes in QOF data
Prescribing	Prescription cost analysis system	Prescription cost analysis system	N/A	
Ophthalmic and dental services	HSCIC	HSCIC	N/A	
Glossary	HES: Hospital Episode Statistics; RC: Reference Costs; HRG4+: Healthcare Resource Groups version 4+; MH: Mental Health; PSSRU: Personal & Social Services Research Unit; QOF: Quality and Outcomes Framework; DH: Department of Health; HSCIC: Health and Social Care Information Centre			
Note	(1) Radiotherapy & High Cost Drugs, Diagnostic Tests, Hospital/patient Transport Scheme, Radiology, Rehabilitation, Renal Dialysis, Specialist Services			

3.2 HES inpatient, day case, outpatient and mental health data

HES is the source of data for both the amount of activity and for the measures of quality for elective and non-elective activity, including mental health care delivered in hospitals.[3] HES comprises almost 19.1m records for 2012/13, and 19.5m records for 2013/14. We convert HES records, defined as Finished Consultant Episodes (FCEs), into Continuous Inpatient Spells (CIPS), using the official algorithm for calculating CIPS published by the Health and Social Care Information Centre.[4] We then count the number of CIPS in each Healthcare Resource Group (HRG), which form the basic means of describing different types of hospital output.

The cost of each CIPS is calculated on the basis of the most expensive FCE within the CIPS, with costs for each HRG derived from the Reference Cost data. We then calculate the national average cost per CIPS in each HRG. Reference Cost data are reported according to a classification system in which activities are divided into 'mapping pots' which capture the method of admission (e.g. 01_EI for elective and 02_NEI for non-elective services). They are then subdivided into department codes (e.g. DC for Day case, NEI_L for non-elective long stay and NEI_S for non-elective short stay) which capture the Point of Delivery. Full details are available in the Reference Cost documentation (Department of Health, 2012).

For elective activity, the average cost for an HRG is calculated as the activity-weighted average cost of all of the HRG activity contained in the reference cost data in the mapping pot '01-EI' and a department code of 'EI'. This intentionally excludes the use of lower day case costs in the calculation of average costs. For non-elective activity, the average cost is the activity weighted average using both the 'NEI_S' and 'NEI_L' department codes from the '02_NEI' reference cost mapping pot.

Frequent changes to the HRG system pose some difficulties in constructing the output index (Grašič et al., 2015). In 2012/13, a new version of the patient classification system HRG4+ was introduced, replacing the old HRG4 system. The number of HRGs increased from 1657 to 2100, with only around 600 overlapping across systems. In 2013/14 there were further updates to the system; however the changes were less dramatic with fewer than 100 HRGs added. As the changes were not dramatic, we were able to use HRG4+ for both years.

3.2.1 *Organisational coverage*

The vast majority of activity captured in HES is performed by hospital trusts. As shown in Table 2, 97.75% of all FCEs were performed in hospital trusts in 2012/13 and, similarly, 97.54% in 2013/14. Activity undertaken by PCTs was still captured in HES in 2012/13 but represented only 0.07% of total activity. With the dissolution of PCTs, their activity has been taken over by trusts, if undertaken at all. The proportion of activity performed by private providers is going up: in 2012/13 they covered 2.13% of all activity, increasing to 2.41% in 2013/14.

[3] As in previous years, we exclude patients categorised to HRGs which are not included in the tariff ("Zero Cost HRGs")
[4] http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=1072

Table 2: Organisational coverage of HES activity

Type of organisation	Year	#FCEs	Total Cost [in million £]
Trusts	12/13	18,649,728	16,199
	13/14	19,061,786	17,517
PCT	12/13	13,058	1,772
Private	12/13	406,078	4,313
	13/14	470,454	4,394
Other[5]	12/13	696	223
	13/14	1,873	301

3.2.2 *Elective, day case and non-elective activity*

Elective and day case activity has been increasing over the whole period, while non-elective activity shows a more erratic pattern, as can be also observed in Figure 3. As can be seen from Table 3, the number of elective CIPS increased by 311,487 (2.44%) between 2012/13 and 2013/14, while there was a decrease in non-elective activity, with 217,283 fewer CIPS performed in 2013/14 than one year earlier.

Table 3: Number of CIPS and average cost for electives and non-electives

	Elective and day case activity		**Non-elective activity**	
	# CIPS	*Average cost*	*# CIPS*	*Average cost*
2004/05	6,433,933	£1,031	6,009,802	£1,210
2005/06	6,864,612	£1,041	6,291,117	£1,241
2006/07	7,194,697	£1,036	6,363,388	£1,244
2007/08	7,598,796	£1,091	6,593,136	£1,237
2008/09	8,148,229	£1,147	6,826,035	£1,354
2009/10	8,465,757	£1,227	6,951,379	£1,413
2010/11	8,755,081	£1,263	7,109,358	£1,460
2011/12	8,946,909	£1,287	7,049,528	£1,498
2012/13	9,030,530	£1,341	7,327,228	£1,532
2013/14	9,342,017	£1,373	7,109,945	£1,543

[5] Organisations with the org_code starting with 8

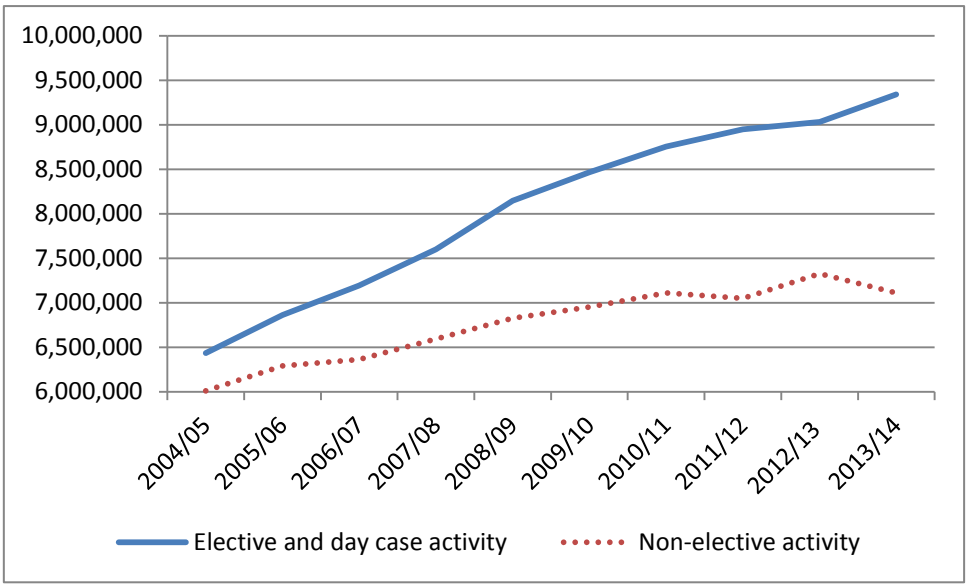


Figure 3 : Changes in elective and day case and non-elective activity

After cost-weighting this activity, we observe 1.85% growth in activity for electives and negative growth of -0.24% for non-elective activity between 2012/13 and 2013/14. Combining both, the total cost-weighted activity growth is 0.97%.

3.2.3 *Elective, day case and non-elective activity: quality adjustment*

Our measure of hospital output captures growth in both the volume of activity and improvements in quality. The quality of hospital activity is measured by 30-day survival rate and by mean remaining life expectancy as well as, in the case of elective and day case activity, by 80th percentile waiting times. Information on waiting times is obtained directly from HES; 30-day survival post-discharge is calculated from the mortality dataset provided by ONS; mean life expectancy is taken from life tables, published by ONS on a yearly basis.[6] Table 4 and Figure 4 through Figure 6 present average values for each of these measures over time.

Table 4: Quality adjustment for elective and day case and for non-elective activity

	Elective and day case activity			**Non-elective activity**	
	30-day survival rate	*Mean life expectancy*	*80th percentile waiting times*	*30-day survival rate*	*Mean life expectancy*
2004/05	99.38%	23.7	104	95.16%	34.1
2005/06	99.47%	23.7	95	95.49%	34.3
2006/07	99.51%	23.6	89	95.65%	34.6
2007/08	99.72%	23.5	74	95.79%	34.7
2008/09	99.74%	23.2	60	95.85%	34.4
2009/10	99.76%	23.4	65	96.07%	34.6
2010/11	99.78%	23.4	76	96.05%	34.8
2011/12	99.45%	23.19	85	96.62%	34.6
2012/13	99.50%	23.18	119	96.45%	34.1
2013/14	99.44%	23.13	94	96.32%	34.1

[6] http://www.ons.gov.uk/ons/rel/lifetables/national-life-tables/index.html

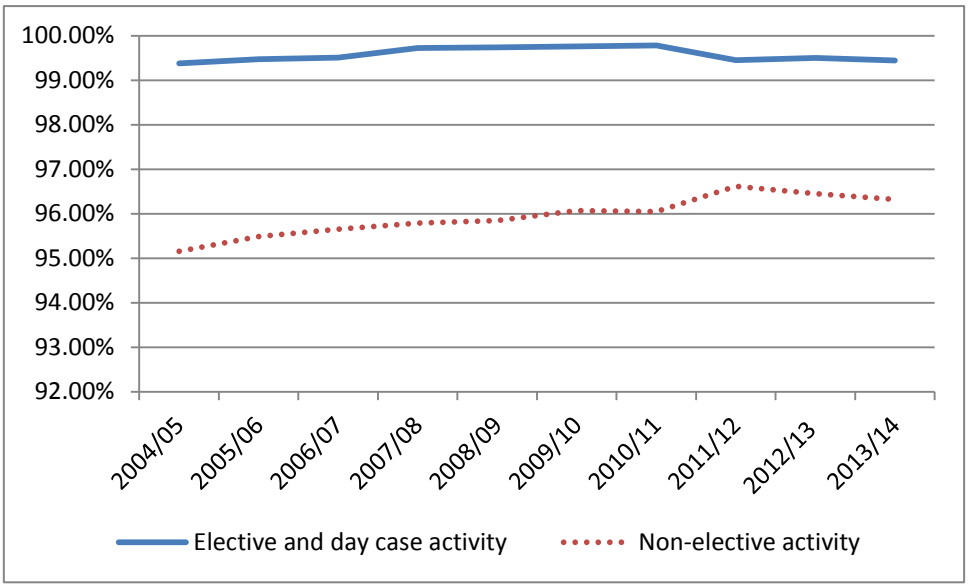


Figure 4 : 30-Day survival rate

As can be seen, overall 30-day survival rate decreased slightly in 2013/14. However, this apparent decline in survival rates is mainly due to a trend of increased activity in those HRGs with relatively lower survival rates. In a like-for-like comparison which compares the activity-weighted mean difference in survival rates for each HRG that appeared in both years, the mean improvement in survival was 0.04% per HRG. As it is the survival improvement per HRG which enters the quality adjustment, there is a positive upward impact of including survival in the quality-adjustment.

There is little variation in mean life expectancy over the entire period, as shown in Figure 5. A slight negative trend can be observed in recent years: this is mostly likely due to an ageing population, rather than lower quality of care.

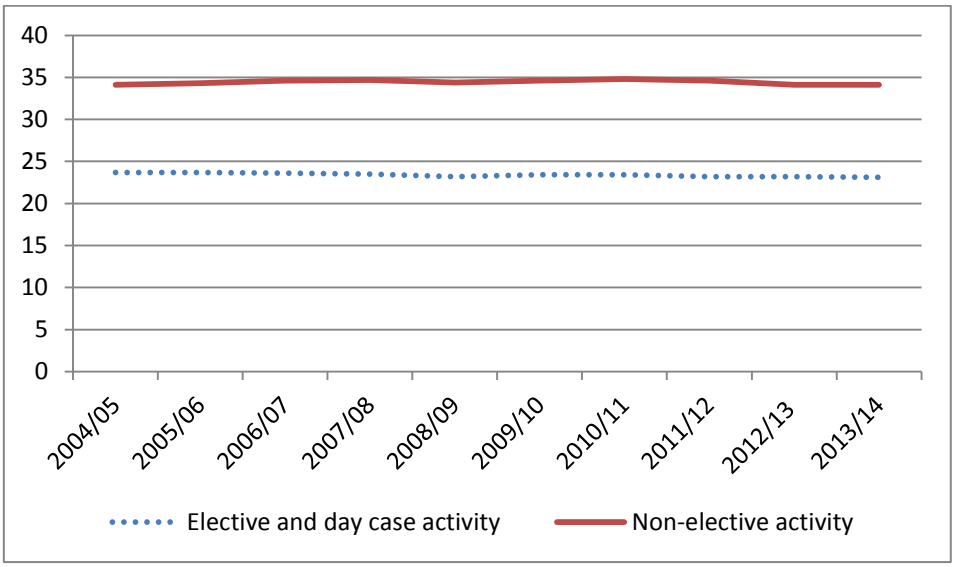


Figure 5 : Mean life expectancy

Waiting times decreased in 2013/14 compared to 2012/13, as shown in Figure 6. Despite this improvement, waiting times remain much higher than in the 5-year period preceding 2012/13.

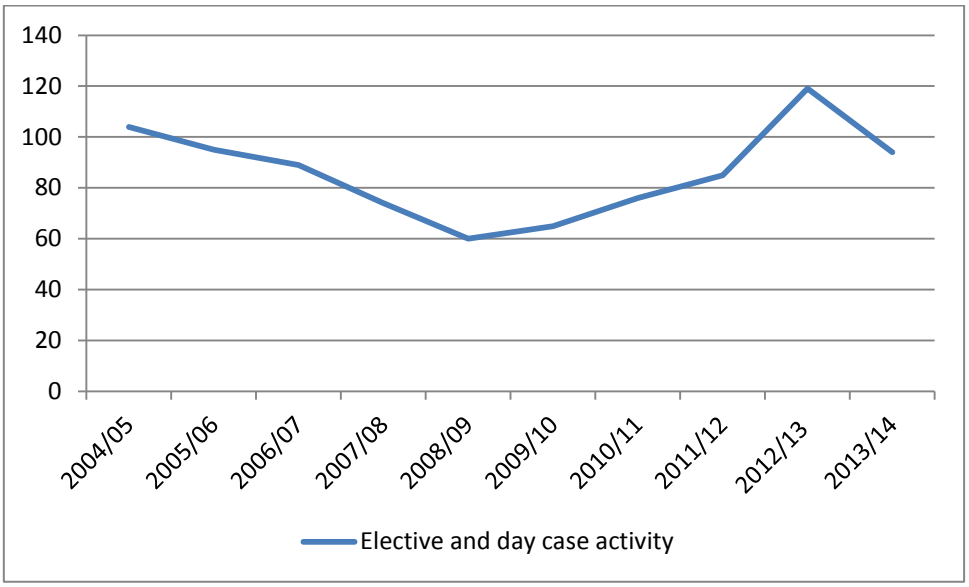


Figure 6 : 80th percentile waiting times

We calculate quality adjustment based on the performance in a specific HRG, separately for electives and non-electives. The numbers in figures 4 to 7 show overall averages across the relevant sector without factoring in any shift of activity towards more complicated cases. We calculate quality adjustments separately for each type of HRG, and separately for electives and non-electives. When we do this, we find that each of our quality adjustors has a positive impact on growth. **Once we take quality adjustment into account, the total Laspeyres output growth of HES activity from 2012/13 to 2013/14 increases from 0.97% to 1.81%.**

3.2.4 *Inpatient mental health*

We identify mental health patients as those for which the HRG falls into the subchapter "WD" (Treatment of Mental Health Patients by Non-Mental Health Service Providers). As seen in Table 5 and Figure 7, we find some year-on-year fluctuation over the last 10 years in the number of patients with mental health problems treated in elective and day case settings, as well as in those receiving non-elective treatment. While the number of non-electives is mostly increasing, the number is falling for elective and day case activity.

Table 5: CIPS and average cost for inpatient mental health patients

	Elective and day case activity		Non-elective activity	
	# CIPS	*Average cost*	*# CIPS*	*Average cost*
2004/05	45,624	£689	123,983	£1,012
2005/06	41,439	£673	120,203	£1,012
2006/07	38,408	£656	115,560	£1,012
2007/08	33,993	£1,141	112,475	£1,364
2008/09	25,792	£1,133	109,636	£1,319
2009/10	28,143	£1,195	121,610	£1,365
2010/11	30,714	£1,297	125,823	£1,445
2011/12	31,142	£1,318	135,315	£1,318
2012/13	31,078	£1,358	145,787	£1,358
2013/14	25,703	£1,368	141,787	£1,385

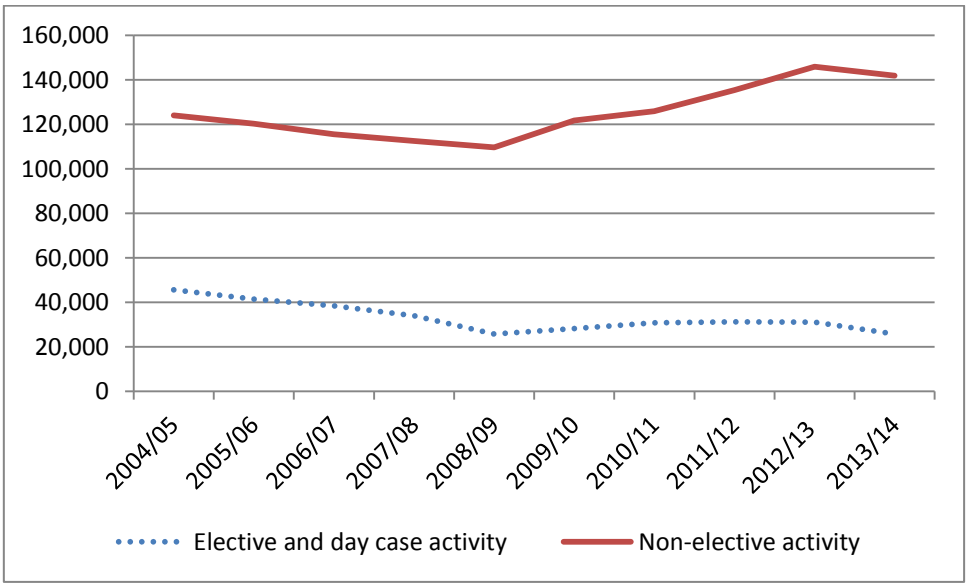


Figure 7 : Number of CIPS for elective, day case and non-elective mental health patients over time

After cost-weighting mental health activity, we observe a decline of -4.95% between the years 2012/13 and 2013/14.[7]

3.2.5 *Inpatient mental health: quality adjustment*

As with other inpatient activity, we also quality-adjust mental health activity. We use the same quality adjusters: 30-day survival rates, mean remaining life expectancy and 80th percentile waiting times, these measures reported in Table 6.

[7] Excluding activity performed at independent treatment centres, quality adjusted output growth equals to 1.44%.

Table 6: Quality adjustments for mental health activity

	Elective and day case activity			Non-elective activity	
	30-day survival rate	*Mean life expectancy*	*80th percentile waiting times*	*30-day survival rate*	*Mean life expectancy*
2004/05	97.72%	30.1	40	96.96%	28.7
2005/06	98.01%	30.0	265	97.22%	28.9
2006/07	98.15%	30.6	257	97.38%	29
2007/08	98.64%	29.9	28	97.65%	27.7
2008/09	98.71%	29.0	42	97.56%	27.3
2009/10	98.61%	29.4	28	97.68%	27.7
2010/11	98.85%	30.2	37	97.63%	27.8
2011/12	98.83%	31.1	37	97.78%	27.3
2012/13	98.41%	29.6	52	97.61%	26.9
2013/14	98.72%	29.5	56	97.52%	26.9

In the same way as for other HES inpatient activity, we also calculate quality adjustment based on the performance in a specific HRG (separated for electives and non-electives). **Once we take quality into account, the total Laspeyres output growth of HES activity for mental health patients from 12/13 to 13/14 decreases further from -4.95% to -5.36%, reflecting recent deteriorations in quality for these patients.**

3.2.6 *HES outpatient activity*

The volume of outpatient activity can be derived from both the HES Outpatient Minimum Dataset and RC data, but we always use RC to determine costs. A like-for-like comparison between the two datasets is not wholly possible because the activity data are recorded somewhat differently in each. Specifically, this is because it is not possible to classify HES activity into consultant led and non-consultant led activity which is the common definitional split for non-procedural activity in RC. For a successful match, one would need consultant codes in HES, which are considered sensitive and were not available to us. HES outpatient activity classification is therefore defined as a combination of treatment speciality and Secondary Uses Survey (SUS) HRG code. A further difference between HES- and RC-recorded activity is that HES covers activity conducted by organisation types other than trusts. HES contains data on appointments which were attended and those which were not. For the purpose of this analysis we only include attendances which were attended, with these representing approximately 80% of recorded data over 2011/12 to 2013/14. Of non-attended appointments there are roughly equal proportions of cancelations by patients, cancelations by providers, and patients who failed to attend without prior warning.

Table 7 : Organisation and activity coverage over time

	2011/12			2012/13			2013/14		
	Orgs	Unique Activity Definitions	Attended Appointments [,000s] (% of all recorded)	Orgs	Unique Activity Definitions	Attended Appointments [,000s] (% of all recorded)	Orgs	Unique Activity Definitions	Attended Appointments [,000s] (% of all recorded)
Trusts	223	6,800	69,765 (79.6%)	217	7,798	72,009 (80.0%)	219	8,860	77,559 (80.2%)
ISHP	32	619	1,728 (85.3%)	39	774	2,813 (86.9%)	61	957	4,494 (87.4%)
PCTs	48	551	1,127 (84.3%)	20	307	632 (87.4%)	0	0	0
CCGs	0	0	-	0	0	0	2	11	1 (77.5%)
Other	0	0	-	0	0	0	5	28	6 (89.8%)

Table 7 shows the organisational and activity coverage over time. For trusts, around 220 organisations have provided data each year, and there has been a steady increase in activity and activity definitions over time. The majority of the activity definition increase appears to be due to an increase in procedures that may also be done in hospitals in a day case or elective setting. For example, in 2013/14 there were approximately 9000 different types of activity spread across four different types of provider classifications (Hospital Trusts, CCGs, Independent Sector Healthcare providers and 'Other' providers).

There is an increasing number of Independent Sector Health Care Providers (ISHP) providing data for an increasing number of categories. These data are included for completeness, but are excluded from our productivity calculations. These data are excluded as the increase in volume is more likely to represent an increase in coverage of an unknown volume of non-NHS activity – including these figures will likely bias the estimates of growth upwards.

PCT activity has, as expected, declined over time and is non-existent in 2013/14. There is a very small amount of CCG outpatient activity from just two CCGs (06H Cambridgeshire & Peterborough and 99H Surrey Downs). There is also a new type of organisational category appearing in 2013/14 called 'Other Providers'. These five providers have codes 8F6, 8HP, 8HT, 8J1 and 8J2 and are not listed in the HSCIC organisation data service database. There is, however, only a small amount of activity associated with these organisations, and they are excluded from our productivity calculations on the same basis as excluding ISHP volume. The numbers are so small that this assumption has no material impact on our measurement.

In order to match consultant-led and non-consultant-led activity definitions from reference costs to those in HES, weighted averages were taken to produce averages specific only to currency codes (e.g. WF01A) and service codes. These averages could then be matched to HES activity. An initial round of matching was based on a complete match of reference cost service and currency code combination with HES treatment speciality and SUS HRG code. This led to over 90% of records being matched to an associated reference cost.

Table 8 : HES outpatient and reference cost matching

	11/12	12/13	13/14
Service & SUS HRG average	85.69%	93.30%	91.61%
Imputed using HRG average	10.43%	1.72%	0.48%
Hard-Coded	1.94%	2.34%	2.58%
Imputed using service average	1.94%	2.65%	5.32%
Imputed using overall average	0.00%	0.00%	1.00%

For those records with an unattached cost, the HRG average was matched where possible. In 2011/12 this led to an additional 10% of records having costs attached, but this figure amounted to less than 0.5% in 2013/14. Inspection of HRGs without any cost data showed a small number of HRGs with large volumes, specifically UZ01Z, SC97Z and NZ05C. UZ01Z and SC97Z HRGs were manually assigned zero costs reflecting their zero tariff prices. NZ05C was assigned a value of £72 for all years as per the non-mandatory outpatient procedure tariff, as listed in the 2013/14 road test tariff spreadsheet.[8] Remaining activity was either assigned a service-level average or an overall reference cost outpatient average.

Table 9 : Volume and average cost over time

Year	All providers (excluding ISHP and 'other providers')		Trusts only	
	Volume	Average cost	Volume	Average cost
2011/12	70,892,793	£113.66	69,765,297	£113.98
2012/13	72,641,731	£116.39	72,009,479	£116.63
2013/14	77,560,439	£116.60	77,559,319	£116.60

Table 9 shows the volume of attended activity and average cost of activity for trusts and all providers excluding ISHP and other providers (i.e. includes trusts, PCTs and CCGs) over time. **Laspeyres growth for all providers was 5.56%, and for trusts only it was 6.26%**

3.2.7 *HES Outpatient Activity: quality adjustment*

We further quality-adjust outpatient activity to take account of changes in waiting times, as summarised in Table 10 and Figure 8. The average 80th percentile waiting time was 38 days in 2012/13, rising to 40 days in 2013/14, so accounting for this has only slight impact on the growth index which is **5.25% for all providers and 5.55% for trusts only.**

[8] https://www.gov.uk/government/publications/payment-by-results-pbr-operational-guidance-and-tariffs See spreadsheet 07_-_Tariff_information_spreadsheet_2013-14.xls

Table 10 Outpatient 80th percentile waiting times

Waiting time - in days	From DH	From HES
2004/05	52	
2005/06	46	
2006/07	41	
2007/08	24	37
2008/09	22	34
2009/10	24	36
2010/11		37
2011/12		37
2012/13		38
2013/14		40

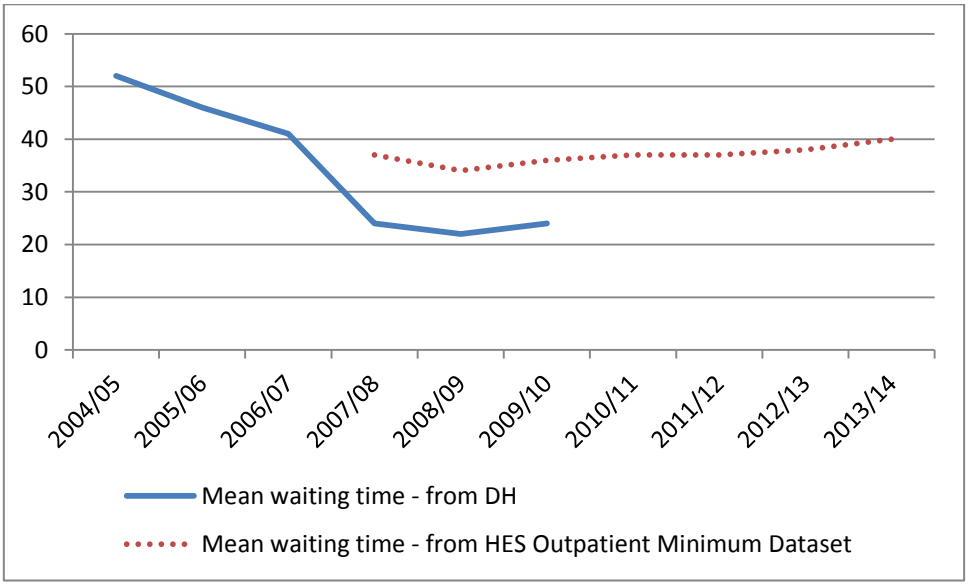


Figure 8 : Trends in outpatient waiting times

3.3 Reference cost data

Reference cost returns are used to capture activity performed in most health care settings other than hospitals, outpatient departments and primary care. Since 2012/13 they only cover activity undertaken by hospital trusts. They also provide information on unit costs for these activities (and about the costs of activity performed in hospitals and outpatient departments). In particular, RC data cover activity conducted in accident and emergency (A&E) departments, mental health and community care settings, and diagnostic facilities. Activities are reported in various ways: attendances, bed days, contacts and number of tests.

There are two major issues that need to be considered when using the reference costs data for our purposes:

1. The accuracy of the reported data
2. Their organisational and activity coverage

3.3.1 *General RC data validation checks*

Recently implemented mandatory and non-mandatory validations of the reference cost data returned by NHS Trusts by DH (Department of Health, 2012) have reduced the year-on-year volatility in the information contained in the RC returns. DH checks of the quality of Reference cost returns are of the following nature:

- Mandatory validations included checks that all data (both activity and cost) are reported, unit costs are reported as positive integers to two decimal places, no fields are missing, etc.

- Non-mandatory validations include checking whether unit costs below £5 or over £50,000 are accurate and whether single professional outpatient attendance unit costs were less than multi-professional unit costs.

- Finally, checks on 'year-on-year changes' are carried out. In particular, any change in total cost or activity greater than 25% is flagged and followed up. The check is carried out by department code and HRG sub-chapter for acute services, or service code for non-acute services (only for outpatient attendances, outpatient procedures and emergency medicine).

Over and above these checks, we have implemented our own validation process (Bojke et al., 2014). These focus on identifying large increases/decreases in either volume or unit costs of activity for all non-acute services. In particular, we check 1) whether volumes of activity have registered either an increase or decrease of more than 500,000 units or 2) whether the value of activity has registered an increase or decrease of more than £25 million.

For 2013/14, a further check has been implemented which looks at the impact of valuing current units of output at last year's prices (a necessary step in the construction of the Laspeyres index).

In the event that large scale changes are detected, we look at each activity in isolation to determine the most appropriate solution. These may be: to leave as is, replace an unexpected high cost value with the minimum cost across the two years, or omit the category from the output index. Our validation checks performed with the RC 2013/14 data do not show any implausibly large changes.

3.3.2 *Organisational and activity coverage*

RC data are always subject to some degree of change over time both in terms of organisational coverage, and of coverage and definition of activities: PCT data were, for example, not collected in 2012/13 despite some PCTs still being active to some degree. Although CCGs and CSUs have replaced the commissioning role that PCTs used to have, they are not thought to directly produce any healthcare outputs. As such, we anticipate that there is little or no CCG or CSU activity that could potentially be collected in RCs. As such, organisational coverage between 2012/13 and 2013/14 has been stable.

In contrast, the number and definitions of individual categories has changed considerably over time, as observed in Table 11. This shows that the major change was between 2011/12 and 2012/13, with a substantial increase in the number of distinct categories from 3,586 to 16,106, although this number reduced to 10,209 in 2013/14. Between 2011/12 and 2012/13 there were major changes in the definition of measurement of mental health, community care and accident and emergency, as described in our previous report (Bojke et al., 2015).

Although there has been no major restructuring between 2012/13 and 2013/14, a large number of category definitions have changed. Figure 9 shows a Venn diagram with each set representing category definitions within a financial year, and the overlap in definitions over time. For example

there are 1,633 categories which appear in all 3 years. Of note are the 5,257 (293 + 4,964) categories in 2013/14 that were not present in 2012/13, although 293 of these categories appeared in 2011/12. These 'new' categories represent 44m units of activity with a total cost of approximately £5.5bn (approx. 16% of all cost-weighted activity in 2013/14). Conversely there are 11,154 (97 + 11,057) categories which appeared in 2012/13 but which no longer appear in 2013/14. These categories had 39.5m units of activity with a total cost of approximately £4.5bn (14%). These substantial year-on-year categorisation changes make it challenging to measure output growth over time.

Table 11: Categorisation over time in reference costs

	2011/12	2012/13	2013/14
Distinct Categories	3,586	16,106	10,209
Units of Activity	780,901,098	826,542,379	863,298,804
Unadjusted Cost	£ 30,680,190,774	£ 31,770,599,163	£ 34,025,100,192

Table excludes hospital based activity covered by HES e.g. elective, non-elective and certain mental health activities (but includes outpatient activity)

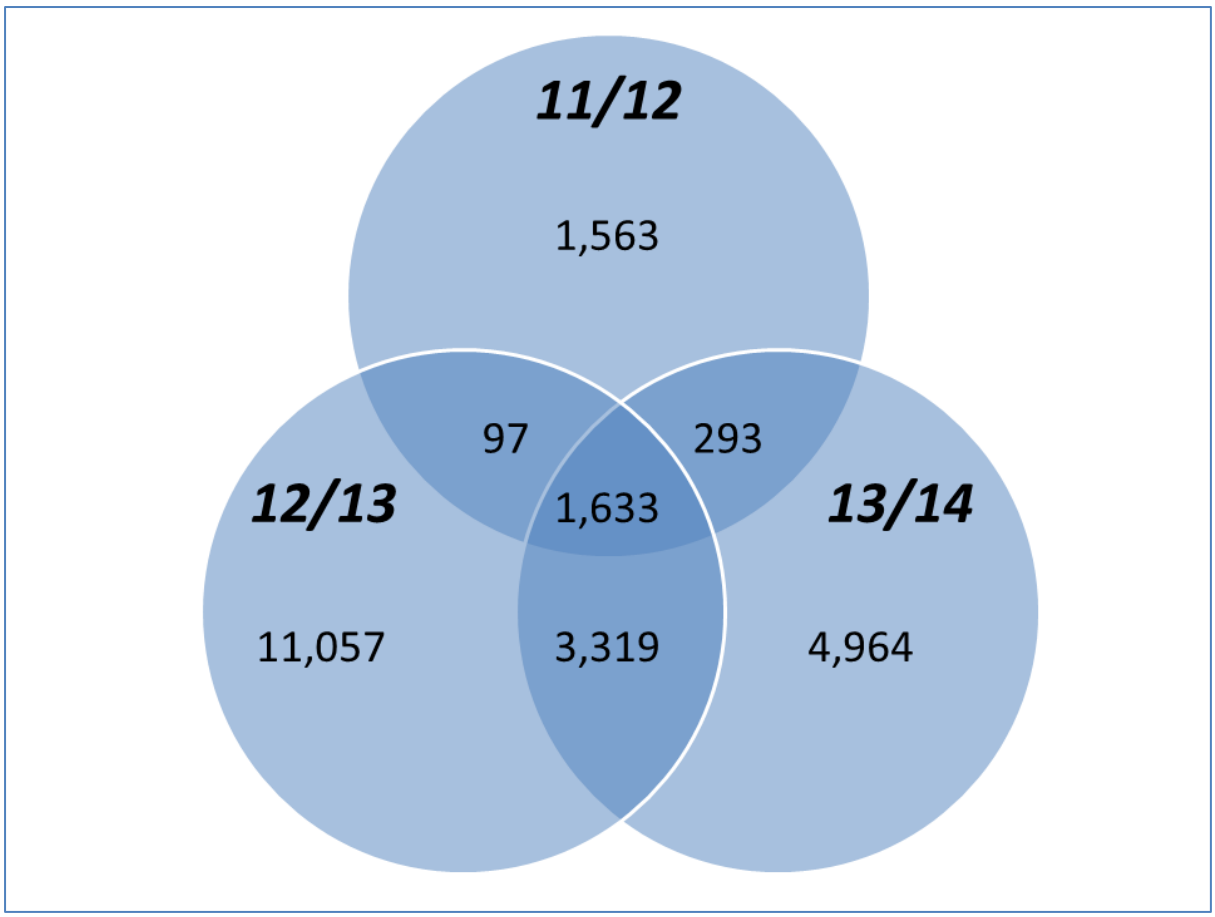


Figure 9 : Venn diagram of reference cost activity definitions 11/12 to 13/14

Table 12: Reference cost settings

Setting	2012/13			2013/14		
	Categories	**Activity**	**Cost**	**Categories**	**Activity**	**Cost**
A&E and Ambulance Services	89	34,952,786	£3,692,014,018	90	35,051,392	£3,923,106,579
Chemo/Radiotherapy & High Cost Drugs	317	6,754,603	£2,652,051,626	323	6,988,301	£2,915,174,231
Community Care	149	79,709,044	£4,139,765,181	174	85,975,592	£4,864,684,367
Diagnostic Tests	64	342,280,609	£941,490,357	72	368,505,992	£964,981,062
Community Mental Health	117	260,266,214	£6,311,927,307	124	259,659,214	£6,410,525,825
Outpatient	6,979	77,222,725	£8,546,218,360	8,055	81,699,802	£9,275,173,143
Radiology	5,047	9,381,616	£859,058,674	136	9,709,456	£904,796,391
Rehabilitation	119	2,715,650	£817,792,033	113	3,002,512	£893,588,640
Renal Dialysis	40	4,135,914	£528,076,698	40	4,079,238	£533,459,915
Specialist Services	86	4,359,263	£2,927,444,066	145	4,699,893	£3,030,502,560
Other	3,099	4,763,955	£354,760,843	937	3,927,412	£309,107,379

Table 12 summarises the RC data according to broad service settings. This shows that nearly half the dropped categories appeared in radiology (down from 5,047 categories to just 136). However, the total activity within the radiology setting increased from 9.3m to 9.7m and the total cost from £860m to £905m. This is indicative of a change in activity definition with a move to broader and less granular definitions. A similar situation occurs in the 'Other' setting, where the largest component of Regular Day and Night Attendances (RDNA) activity drops from 3,084 different definitions to just 919 types.

We deal with each of these changes in more detail in their relevant sections, but the main conclusion is that there are no substantial consequences for RC growth measurement. This is because, although category descriptions differ, the old and new categories are capturing the same types of activity.

3.3.3 *RC outpatient activity*

Outpatient activity as measured in the RC database has tended to be classified into three major groups: consultant led activity; non-consultant led activity; and procedures. Consultant and non-consultant led activity represent broadly the same set of outpatient specific HRG-style codes (currency codes beginning with WF) and outpatient procedure codes represent procedure related HRGs which may appear in other hospital settings (for example in 2013/14 reference costs, HRG AA21G [minor intracranial procedures] occurred 1,648 times as a hospital day case and 3,662 times as an outpatient procedure). On average, consultant led activity for trusts represents over 71% of overall outpatient cost-weighted activity. Outpatient procedures have increased considerably in volume: representing just 3% of overall outpatient activity in 2007/08 and nearly 12% in 2013/14.

Table 13: Outpatient activity and cost

Year	All providers		Trusts only	
	Volume	Average cost	Volume	Average cost
2007/8	69,679,600	£94.04	61,508,362	£98.40
2008/9	74,421,017	£98.36	65,804,814	£102.79
2009/10	80,093,906	£101.47	71,115,142	£105.30
2010/11	81,301,615	£105.37	73,621,984	£107.11
2011/12			75,826,947	£108.23
2012/13			77,222,725	£110.67
2013/14			81,699,802	£113.53

The Laspeyres index of growth for outpatient activity was 7.79% from 2012/13 to 2013/14 and 7.78% after adjusting for quality.

The difference between HES and RC measures of growth is fairly substantial and amounts to 2.23% difference with HES quality-adjusted growth measured at 5.55%. Although both datasets have some quality issues, our preferred method is using HES, as it is a patient level dataset as opposed to the more aggregated RC. This allows us to perform more thorough quality checks and better assure a like-for-like comparison.

3.3.4 *A&E and ambulance services*

Table 14 reports summary statistics for A&E services provided in Emergency Departments and Other A&E services according to whether patients were subsequently admitted to hospital (AD) or not admitted (NAD).

Emergency departments offer a consultant-led 24 hour service with full resuscitation facilities and designated accommodation for the reception of A&E patients.[9] Between 2012/13 and 2013/14 there was a slight decrease (of 1.6%) in the total number of emergency department attendances, with the greatest drop occurring in the A&E attendances leading to people being admitted to hospital.

The category 'Other A&E services' captures activities carried out in any of the following departments: 'Consultant led mono specialty accident and emergency services (e.g. ophthalmology, dental) with designated accommodation for the reception of patients', 'Other type of A&E/minor injury activity with designated accommodation for the reception of accident and emergency patients' and 'NHS Walk-in-Centres'. Overall, the total volume of A&E activity increased by 0.62% between 2012/13 and 2013/14.

[9] http://www.hscic.gov.uk/article/3966/HES-AE-Data-Dictionary

Table 14: A&E activity and average cost

Year	Emergency Departments				Other A&E services			
	AD		NAD		AD		NAD	
	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost
2006/7	3,464,869	107	10,327,147	83	281,135	50	3,900,718	36
2007/8	3,326,719	121	9,058,765	89	531,498	70	3,769,765	43
2008/9	3,566,642	118	9,708,958	99	1,000,986	49	4,184,796	49
2009/10	4,047,176	134	10,075,701	103	1,090,650	49	3,628,469	50
2010/11	4,004,868	141	9,881,747	108	1,145,125	62	3,800,261	55
2011/12	4,040,760	157	10,405,762	108	616,812	83	3,253,452	52
2012/13	4,345,100	160	10,292,933	115	362,656	90	3,426,231	59
2013/14	4,218,480	177	10,189,225	127	494,549	80	3,639,355	59

Legend: AD – leading to admitted patient care; NAD – Not leading to admitted patient care

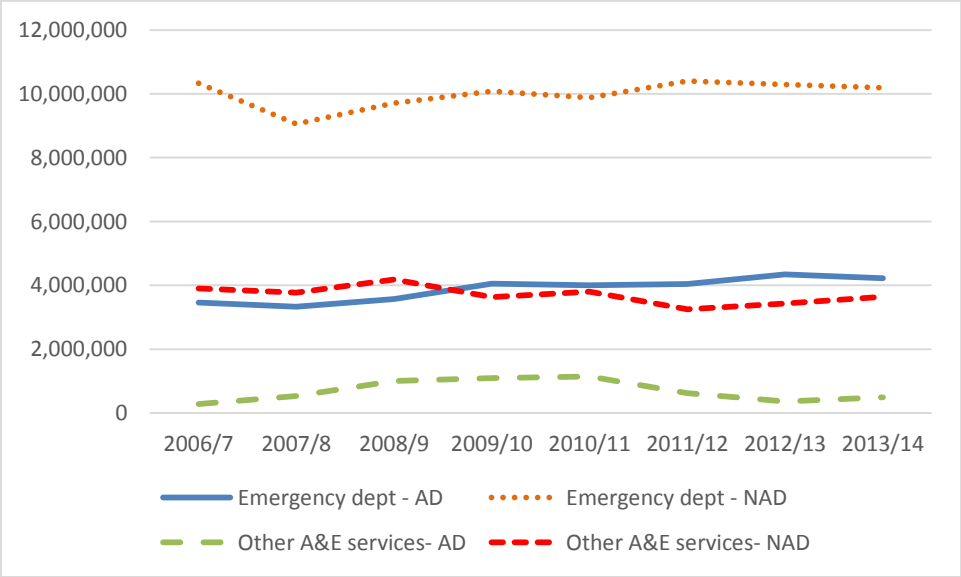


Figure 10: trend of A&E activity across settings

Ambulance services are reported in Table 15 for the three years since their introduction in the Reference cost database. Activity is measured in terms of calls received for the category 'Calls'; patients for the category 'Hear' and incidents for the category 'See'. Both the number of calls and the total number of patients for the category 'Hear' decreased in 2013/14, whilst the total number of incidents for the category 'See' have increased year-on-year since 2011/12.

Table 15 Ambulance services

	2011/12	2012/13	2013/14
Ambulance Services			
Calls			
Volume of activity	8,530,563	9,120,422	8,926,215
Average cost (£)	8	7	7
Hear and treat or refer			
Volume of activity	338,022	423,821	400,005
Average cost (£)	44	47	44
See and treat or refer			
Volume of activity	1,862,892	1,997,327	2,113,757
Average cost (£)	173	174	180
See and treat and convey			
Volume of activity	4,895,376	4,984,296	5,069,806
Average cost (£)	230	230	231

The Laspeyres output growth measure for the setting 'A&E services', which includes ambulance services, increased by 3.04% between 2012/13 and 2013/14.

3.3.5 *Chemotherapy, radiotherapy and high cost drugs*

The categories used to describe chemotherapy, radiotherapy, and high cost drugs have been subject to substantial revision over time, making it difficult to infer much from the simple counts of activity reported in Table 16. Between 2012/13 and 2013/14, however, categorisation has been stable, with the total volume of Chemotherapy activity increasing by 0.6%, that of Radiotherapy by 1.6% and that of High Cost Drugs by 11.6%.

The Laspeyres output growth measure for Chemotherapy, Radiotherapy & High Cost Drugs was 9.3% between 2012/13 and 2013/14. Although this rate is high, it is smaller than in previous years, as can be seen in Figure 11.

Table 16 Chemotherapy, radiotherapy, high cost drugs

Year	Chemotherapy		Radiotherapy		High cost drugs	
	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost
2004/5	777,312	363	1,622,278	113	-	-
2005/6	763,806	432	1,634,156	126	-	-
2006/7	1,642,444	280	1,743,490	123	26,277,491	17
2007/8	846,425	406	1,613,135	559	1,332,996	305
2008/9	1,428,561	448	1,710,525	157	1,322,354	473
2009/10	1,414,872	505	1,835,695	163	2,412,988	384
2010/11	1,515,845	515	2,001,798	161	1,288,460	818
2011/12	1,769,727	505	2,492,431	137	1,372,131	902
2012/13	2,525,935	387	2,717,024	127	1,511,644	878
2013/14	2,540,353	431	2,760,237	134	1,687,711	859

Note: In 2006/7, high cost drugs were recorded as number of procurements, after which recording was by number of patients

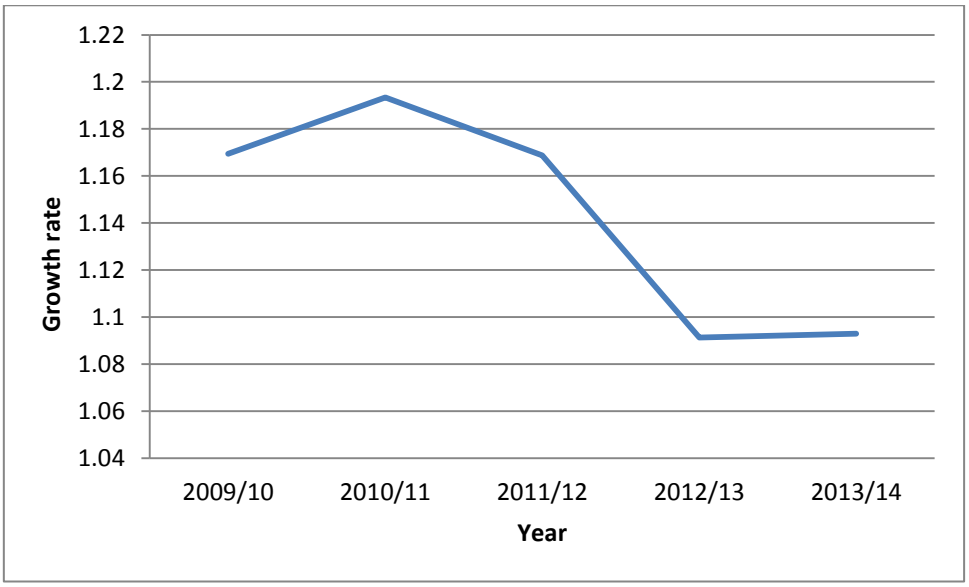


Figure 11: Laspeyres output growth for chemotherapy, radiotherapy and high cost drugs over time

3.3.6 *Community care*

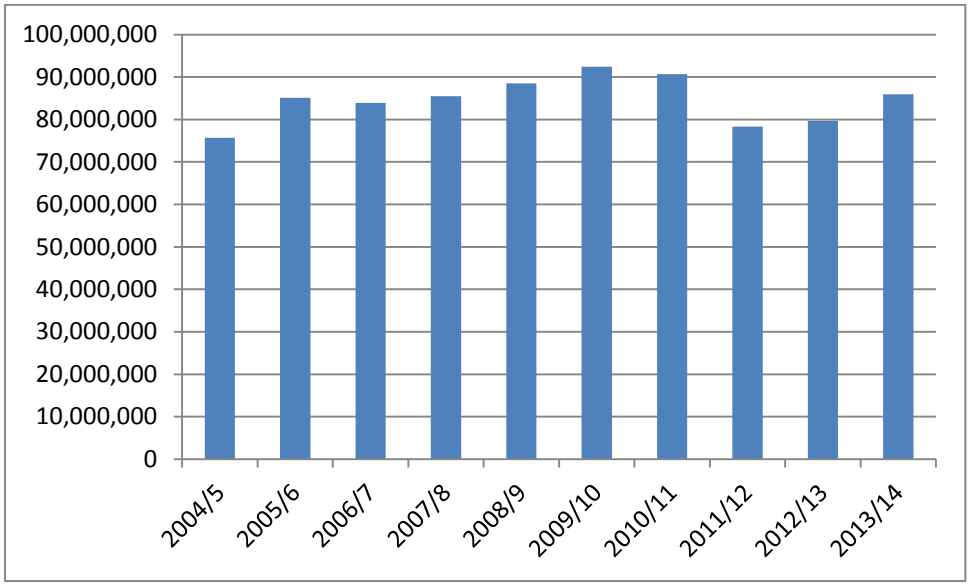
Table 17 reports total volumes of community care activity from 2004/05 to 2013/14. While the provision of community care has decreased since 2009/10, this is primarily due to PCTs (and Personal Medical Services pilots) no longer reporting this activity after 2010/11. Community care activity increased by 6 million units of activity (7.9%) between 2012/13 and 2013/14.

Table 17 Community care activity

Year	Community care	
	Volume of activity (a)	Average cost (£)
2004/5	75,673,792	39
2005/6	85,092,838	38
2006/7	83,895,139	40
2007/8	85,470,688	42
2008/9	88,513,663	45
2009/10	92,412,727	46
2010/11	90,724,524	47
2011/12	78,315,576	50
2012/13	79,709,044	52
2013/14	85,975,592	57

Notes: (a) In 2011/12, PCTs and PMS ceased to report activity about community care. Total volume of activity from 2011/12 is, therefore, not comparable with previous years.

Table 18: Trends in community care activity



The RC data and documentation (Department of Health, 2014) reveal three types of activities newly introduced in 2013/14: Community Intermediate care activity, Wheelchair services and Other Therapists.

1. Community Intermediate care activity: Three new categories of intermediate care services have been created to align three existing classes of categories: admission avoidance schemes; community rehabilitation teams; and hospital at home and early discharge schemes. Whilst the realignment of existing services may create a small issue of assigning the correct lagged cost, there is an additional problem in that not all the covered services appear to have been collected in previously – there are no obvious past RC categories that cover admission avoidance schemes. In addition, there appears to be no smooth mapping of

the two pre-existing categories (community rehabilitation teams and hospital at home and early discharge schemes). For example, the three new categories cover 5.7m units of activity and have a cost-weighted value of £650m with only one category having (just) fewer than 1m units of activity. Hospital at Home and Early Discharge Scheme categories accounted for 286k units of activity in 2012/13, with a cost-weighted value of £31m, and community rehabilitation teams also covered approximately 285k units of activity, with a cost-weighted value of £197m. As the new and old categories do not appear to align at all, for the base case calculation of output growth we have opted to drop the lagged-cost weighted value of the new intermediate care services from the numerator of the Laspeyres volume index. In order to compare like with like, we also drop community rehabilitation teams and hospital at home and early discharge schemes from in 12/13.

2. Wheelchair services: 2013/14 also saw the introduction of 26 new wheelchair categories with nearly 650k units of activity and a cost-weighted value of £137m. Our understanding is that this is new recording of an existing activity which was previously unrecorded. Therefore inclusion of this data would falsely over-estimate growth because the activity was previously uncounted. Our solution is to omit this category from the growth calculation until data are available for at least two years.

3. Other Therapists: 2013/14 also saw the introduction of 'Other Therapists' categories to cover art, drama and music therapists and complementary or alternative medicine therapists. There are 4 new categories with nearly 250k units of activity and a cost-weighted value of £19m. As with wheelchair services, we believe that these categories represent new recording of an existing service and so we omit them from the current calculation.

The total volume of the new three new types of activities introduced in 2013/14 is equal to over 6.5 million units of activity. This explains much of the recorded increase in Community Care activity between 2012/13 and 2013/14. If including these three newly introduced activities, output growth for the Community Care setting is 17.4%. **Dropping the new activity (and partly displaced old activity) from the calculation gives a Laspeyres growth of 3.2%**[10]**.**

[10] As part of the unmapped and non-comprehensive previous activity now included in intermediate care both lagged Hospital at Home (285,754 units) and lagged community rehabilitation team activity (2,851,158 units) were also dropped from the calculation. Note that the Hospital at Home activity had previously been included in the 'Other' setting rather than community care.

3.3.7 *Diagnostic tests, pathology and radiology*

Table 19: Directly accessed diagnostic and pathology services and radiology

Year	Directly accessed diagnostic services		Directly accessed pathology services		Radiology	
	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost
2004/5	369,988	44	180,676,234	3	5,152,720	31
2005/6	465,622	44	221,966,384	2	5,784,605	33
2006/7	735,569	137	236,269,050	2	23,918,500	59
2007/8	776,368	41	257,249,379	2	7,614,437	103
2008/9	804,607	46	278,917,852	2	7,852,498	102
2009/10	1,063,744	43	300,010,031	2	8,347,404	104
2010/11	1,458,025	39	320,418,662	2	8,491,834	97
2011/12	5,640,762	34	333,108,317	2	8,758,136	93
2012/13	6,339,016	30	335,941,593	2	9,381,616	92
2013/14	6,553,727	31	361,952,265	2	9,709,456	93

Note: In 2004/05 and 2005/06, radiology was recorded as number of tests; in 2006/7 it comprised number of tests and interventions; from 2007/08 it was number of patients.

The number of distinct categories in Radiology fell from 5,047 categories to just 136. Further inspection revealed this to be a result of a decrease in the granulation of measurement. For example, whilst the currency code RA01A (MRI Scan, one area, no contrast, age 19 years or over) appeared in 176 distinct categories in 2012/13 due to service description (Direct Access, Outpatient and Other) and "further service information" (general surgery to chemical pathology and global trust codes), it only appears in three distinct codes in 2013/14, sub-divided by service description (Direct Access, Outpatient and Other). It appears that the "further service information" is no longer recorded. The definitions of RA01A in 2013/14 have reverted to what they were in 2011/12.

This creates a minor issue with constructing the Laspeyres index, as we are required to weight current activity by last year's costs. In the case of the three 2013/14 RA01A types of activity we do not automatically have the equivalent of last year's costs. Our general approach to such issues has been to impute lagged costs from the nearest available observed cost or, in cases where we have observations either side of a missing cost, the geometric mean. As the 2013/14 definitions match the 2011/12 definitions, the imputed cost is the average of the observed costs at 2013/14 and 2011/12. For example in the case of Outpatient RA01A the observed cost in 2013/14 was £144.60 and the equivalent cost in 2011/12 was £144.51. The imputed lagged cost for 2013/14 is therefore £144.56. An alternative approach would be to consolidate the more granular 2012/13 definitions into definitions that match 2013/14. In this case the consolidated average cost for Outpatient RA01A would be £148.18. Given the minimal differences between the approaches we have applied the imputation approach rather than adopting a piece-meal matching process.

The total volume of Directly Accessed Diagnostics services, Directly Accessed Pathology services and Radiology increased by 3.39%, 7.74% and 3.35% respectively. **The Laspeyres output growth for each category was 2.27%, 18.9% and 7.45% respectively, leading to an overall growth for these combined activities of 11.70%.** Although this represents a large growth it is not out of line with historical growth in these areas, and represents a small component (1.34%) of output overall.

3.3.8 *Community mental health*

Table 20 summarises overall counts of community mental health activity since 2004/5. Activity in this setting underwent a major revision in 2011/12 with the creation of mental health clusters but has since appeared to settle into a consistent measurement scheme. Table 21 provides a more detailed breakdown of community mental health activity since the clusters were first employed.

Table 20 Community mental health

Year	Community mental health		
	Volume of activity	Volume of activity (a)	Average cost (£)
2004/5	16,389,891		164
2005/6	17,738,894		170
2006/7	19,259,205		167
2007/8	21,751,043		153
2008/9	22,674,811		157
2009/10	23,440,616		161
2010/11	24,341,950		159
2011/12		224,329,080	28
2012/13		260,266,214	24
2013/14		259,659,214	25

Notes: (a) Due to reclassification of activity in community mental health, data is not directly comparable with data reported in previous years.

Table 21: Care clusters and other mental health activity

Community mental health	2011/12		2012/13		2013/14	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
Care Clusters						
Mental Health – Care Clusters – Admitted Patient Care	5,900,173	334	5,548,751	348	8,822,616	222
Mental Health - Care Clusters - Non-Admitted Patient Care	208,657,970	11	244,072,900	9	239,045,781	9
Mental Health – Care Clusters – Initial Assessment	418,356	251	816,112	264	746,982	281
Total volume 'Mental Health Care Clusters'	**214,976,499**	**20**	**250,437,763**	**17**	**248,615,379**	**17**
Other Mental Health						
Secure Units	1,537,140	523	1,526,840	532	1,543,448	516
Day Care Facilities: Regular Attendances	28,782	294	34,969	294	41,555	305
Outpatient Attendances*	1,343,458	156	615,632	217	721,849	182
Community Contacts	3,309,410	135	2,970,529	161	2,642,912	188
Specialist Teams	3,133,791	140	4,680,481	120	6,094,071	117
Total volume Other Mental Health	**9,352,581**	**204**	**9,828,451**	**203**	**11,043,835**	**195**
Total volume of Community MH activity	**224,329,080**	**28**	**260,266,214**	**24**	**259,659,214**	**25**

In terms of raw activity, community mental health increased by 2.9% from 2012/13 to 2013/14. The initial Reference cost data published on the website suggest an increase of 18.7% between 2012/13

and 2013/14 but this was an artefact created by incorrect by one trust (Sussex Partnership NHS Foundation Trust). The figures on the website were subsequently corrected.

Once the data from this Trust are omitted, **we observe a slight decrease in cost weighted activity between years 2012/13 and 2013/14. Laspeyres output growth for community mental health equals to -0.45%.**

3.3.9 *Rehabilitation and renal dialysis*

Table 22 Rehabilitation and renal dialysis

Year	Rehabilitation		Renal dialysis	
	Volume of activity	Average cost	Volume of activity	Average cost
2004/5	4,095,087	178	8,232,432	52
2005/6	4,509,489	185	6,819,136	64
2006/7	3,028,598	241	4,200,298	104
2007/8	2,732,048	259	3,980,793	114
2008/9	3,277,757	265	4,091,245	120
2009/10	3,277,430	279	4,050,658	129
2010/11	3,314,085	285	4,088,817	129
2011/12	2,897,721	278	4,166,150	129
2012/13	2,715,650	301	4,135,914	128
2013/14	3,002,512	298	4,069,460	131

The total volume of Rehabilitation services increased by 10.6% between 2012/13 and 2013/14, whilst the total volume of Renal Dialysis decreased by 1.6% over the same time period. **The Laspeyres output growth for Rehabilitation and Renal Dialysis services were, respectively, 12.1% and 0.3% between 2012/13 and 2013/14.**

3.3.10 *Specialist services*

The volume and cost of various types of specialist services are reported in Table 23.

Table 23: Specialist services

Year	Adult Critical Care		Specialist Palliative Care		Cystic Fibrosis		Cancer Multi-Disciplinary Team Meetings	
	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost
2004/5	2,184,333	828	-	-	16,317	1,919	-	-
2005/6	2,197,135	895	-	-	13,704	2,316	-	-
2006/7	2,468,777	840	93,880	269	13,944	2,290	-	-
2007/8	2,165,060	931	208,410	219	15,383	2,349	-	-
2008/9	2,354,447	967	262,305	216	20,756	2,116	-	-
2009/10	2,439,661	1,003	359,121	192	20,323	2,468	-	-
2010/11	2,470,065	1,011	512,972	162	19,942	2,631	-	-
2011/12	2,570,571	998	550,417	166	9,852	8,476	837,418	114
2012/13	2,669,343	984	600,848	169	9,735	8,709	1,079,297	106
2013/14	2,708,897	992	701,439	158	9,990	10,213	1,279,567	101

Adult critical care services have become more granular in 2013/14 compared to 2012/13, expanding from 20 to 81 different types of services. No mapping between the new categories and the old ones was possible.

The total volume of Critical Care services increased by 1.5%, that of Specialist Palliative care by 16.7%, that of Cystic Fibrosis by 2.6% and that of Cancer Multi-Disciplinary Team Meetings activity by 18.6% between 2012/13 and 2013/14.

Taken together, Laspeyres output for these specialist services grew by 3.5% between 2012/13 and 2013/14.

3.3.11 *Other reference cost activities*

Other types of activity reported in the reference costs are summarised in the following tables. The way of classifying these activities has changed somewhat over time, so rarely are the series recorded in a consistent fashion across all years. Some recording of some types of activity are occasionally discontinued, or subsumed under other broad categories.

Table 24 Regular admissions, ward attenders and day care

Year	**Regular day and night admissions**		**Audiological services**		**Day care facilities**		**Hospital at home**	
	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost	Volume of activity	Average cost
2004/5	122,447	248	1,902,390	41	735,070	124	434,698	73
2005/6	177,131	245	1,692,721	40	649,963	131	593,586	60
2006/7	179,927	271	2,905,175	50	439,932	135	470,737	74
2007/8	164,651	324	3,447,049	51	384,048	137	405,271	73
2008/9	198,573	341	3,716,333	51	345,371	159	522,047	68
2009/10	152,079	393	3,807,539	52	319,706	156	495,961	81
2010/11	176,169	431	3,927,780	51	321,386	148	364,352	91
2011/12	176,877	428	4,033,290	50	275,819	140	323,213	113
2012/13	210,984	371	4,030,693	52	237,040	157	285,754	108
2013/14	204,831	400	3,483,549	55	239,032	146	0	-

The total volume of Regular Day and Night Admissions (RDNA) activity decreased by 2.9%, whilst that of patients treated in Day Care Facilities increased by 0.8% between 2012/13 and 2013/14. The total volume of audiological services decreased by 13.6% between 2012/13 and 2013/147. Hospital at Home services are now covered under Community Intermediate Care activities in the community care setting.

The cost-weighted output growth measure for 'Other NHS activity' is negative, at -5.5%, between 2012/13 and 2013/14.

3.3.12 *Total reference cost growth*

Including outpatient data, the activities recorded in the reference cost returns grew by 4.81% from 2012/13 to 2013/14. The growth was mainly a result of the larger categories (A&E, Community Care, Mental Health and Specialist services) growing at around 3%, with a number of the smaller categories (Chemo/Radiology and High Cost Drugs ; Diagnostic Tests, Radiology ; and Rehabilitation) all showing growth above 7.5%. **Excluding Outpatient activity, the data contained in Reference cost returns suggest that output grew by 3.70% from 2012/13 and 2013/14.**

3.4 Dentistry and ophthalmology

Information about dentistry is derived from the HSCIC website[11] with dental activity differentiated into dental bands, as shown in Table 25. The HSCIC publication on NHS Dental Statistics also reports a weighted measure of courses of treatments, Units of Dental Activity (UDA), which reflect the relative costs of different courses of treatments. We use UDA measures to construct the Laspeyres growth measure for dentistry.[12]

[11] http://www.hscic.gov.uk/catalogue/PUB11625

[12] Prior to 2011/12 we used unit costs of dental treatment as weights, but these proved equivalent to the underlying weights used to construct UDAs.

Table 25: Dental services

Year	Dentistry						
	Band 1	**Band 2**	**Band 3**	**Urgent**	**Other**		**Total**
	(UDA)						
2004/5*	-	-	-	-	-		68,983,268
2005/6*	-	-	-	-	-		69,863,311
2006/7	19,012,890	32,063,007	18,349,548	3,457,446	767,309		73,650,200
2007/8	19,275,334	32,975,610	20,214,444	3,759,851	735,804		76,961,043
2008/9	19,803,371	34,468,755	22,314,288	4,012,151	755,832		81,354,397
2009/10	20,346,012	35,098,905	25,034,148	4,210,866	767,980		85,457,911
2010/11	20,718,874	35,414,322	26,249,796	4,338,032	743,265		87,464,289
2011/12	20,886,648	35,586,987	26,604,720	4,422,493	742,657		88,243,506
2012/13	21,016,444	35,252,547	26,871,444	4,454,437	502,932		88,097,804
2013/14	21,685,314	35,404,479	26,786,916	4,622,964	191,761		88,691,434

As shown in Figure 12, dental output went up in all bands over time, with a slight increase between years 2012/13 and 2013/14. The Laspeyres growth rate is 0.54% for this period.

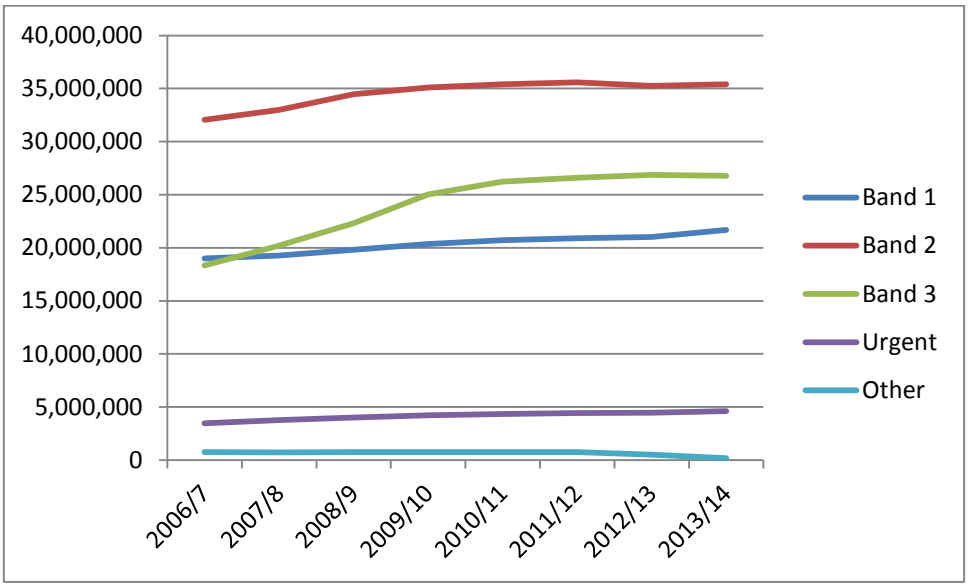


Figure 12: Number of dentistry consultations over time

Data about the volume of activity for community ophthalmology is published by HSCIC on a yearly basis[13]. Table 26 presents the volume of activity and cost for ophthalmic services over time.

[13] http://www.hscic.gov.uk/catalogue/PUB11233

Table 26: Volume and average cost in community ophthalmology

Year	Ophthalmology	
	Volume of activity	Average cost
2004/5	10,148,978	33
2005/6	10,354,682	35
2006/7	10,484,922	36
2007/8	11,047,890	28
2008/9	11,278,474	28
2009/10	11,811,651	28
2010/11	11,938,529	28
2011/12	12,305,727	28
2012/13	12,339,253	28
2013/14	12,787,430	28

There was an increase in ophthalmic activity between the years 2012/13 and 2013/14, leading to cost-weighted output growth of 3.63%.

3.5 Primary care activity

As in previous years, comprehensive data covering primary care activity remains unavailable. For the period 2004/05 to 2008/09 the volume of GP consultations was obtained from QResearch (Fenty et al., 2006, QResearch, 2009). When this survey was discontinued, we initially instead used the General Lifestyle Survey from 2009/10 to 2010/11 (Bojke et al., 2012) and, since 2010/11, we have used data from the GP Patient Survey.[14] The survey has been running since 2007 in different time intervals; since 2011 it has been conducted every six months. In the last round, some 1.32m patients were sent a questionnaire between July and September 2014. The current response rate is around 34%.[15] To assess how much activity is undertaken in primary care, we look at the percentage of participants who answered that they had seen or spoken to their GP in the last 3 months. The responses are weighted to ensure they are representative of the general population.

In the absence of recent information, we assume that the proportion of each consultation type has remained unchanged since 2008/09. The cost of primary care activity comes from an annual calculation published by Personal Social Services Research Unit (PSSRU) and available online.[16] For 2013/14 the cost of GP home visits is not available; therefore, we use the same cost as last year, inflated by the general increase in total GP cost.

In 2013/14 the percentage of people who saw or spoke to GP in the last 3 months declined from 54.83% in 2012/13 to 54.28% in 2013/14. This decrease follows two years in which these percentages increased.

[14] https://gp-patient.co.uk/
[15] http://gp-survey-production.s3.amazonaws.com/archive/2014/July/1301375001_Y8W2%20National%20Summary%20Report_FINAL%20v1.pdf
[16] http://www.pssru.ac.uk/project-pages/unit-costs/2014/

Table 27: GP activity by type

		GP Home visit	GP Telephone	GP Surgery	GP Other	Practice Nurse	Other Clinicians	Total
2004/05	**Activity**	5,800	12,500	148,300	4,200	84,600	10,200	**265,600**
	Cost	69	30	24	24	10	15	**20**
2005/06	**Activity**	6,000	14,000	153,900	4,800	93,700	10,700	**283,100**
	Cost	69	27	24	24	10	15	**20**
2006/07	**Activity**	5,900	15,100	156,600	5,000	99,000	11,400	**293,000**
	Cost	55	21	34	34	9	14	**25**
2007/08	**Activity**	5,900	16,200	155,800	4,800	98,500	11,300	**292,500**
	Cost	58	22	36	36	11	15	**26**
2008/09	**Activity**	6,000	18,700	158,800	5,500	100,600	10,800	**300,400**
	Cost	117	21	35	35	11	14	**27**
2009/10(a)	**Activity**	6,000	18,700	158,800	5,500	100,600	10,800	**300,400**
	Cost	120	22	36	36	12	17	**28**
2010/11(a)	**Activity**	5,844	18,212	154,659	5,357	97,977	10,518	**292,567**
	Cost	121	22	36	36	13	25	**29**
2011/12(a)	**Activity**	6,067	18,909	160,578	5,562	101,726	10,921	**303,764**
	Cost	110	26	43	43	14	25	**33**
2012/13(a)	**Activity**	6,160	19,200	163,047	5,647	103,290	11,089	**308,433**
	Cost	114	27	45	45	13	25	**34**
2013/14(a)	**Activity**	6,098	19,007	161,405	5,590	102,250	10,977	**305,328**
	Cost	114	28	46	46	14	25	**35**

Survey data maintain the same target sample size over time. Consequently, we adjust responses for population growth, estimates for which are available from the Office of National Statistics.[17]

Quality indicators for primary care are taken from the Quality & Outcomes Framework (QOF), but in 2013/14 there was a major restructuring of QOF codes and definitions[18]. In previous years the following QOF indicators were used as our quality indicators:

1. Coronary heart disease (CHD06)
2. Stroke (Stroke06)
3. Hypertension (BP05)

These have now been changed to the following:

1. CHD002 - The percentage of patients with coronary heart disease in whom the last blood pressure reading (measured in the preceding 12 months) is 150/90 mmHg or less *(Threshold change and 15-12 month change)*

[17] http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/2013/sty-population-changes.html

[18] http://www.nhsemployers.org/~/media/Employers/Documents/Primary%20care%20contracts/QOF/2013-14/Summary%20of%20QOF%20changes%20for%202013-14%20-%20England%20only.pdf

2. STIA003 - The percentage of patients with a history of stroke or TIA in whom the last blood pressure reading (measured in the preceding **12** months) is 150/90 **mmHg** or less *(Minor wording change (**noted in bold**) AND 15-12 month change)*
3. HYP002 - The percentage of patients with hypertension in whom the last blood pressure reading (measured in the preceding 9 months) is 150/90 mmHg or less *(Minor wording change, point and threshold change)*

Table 28: Quality adjustment for primary care

	Prevalence			QOF achievement		
	CHD	**Stroke**	**Hypertension**	**CHD**	**Stroke**	**Hypertension**
2004/05	3.57	1.63	10.41	78.60	73.13	64.33
2005/06	3.57	1.66	11.48	84.44	81.22	71.05
2006/07	3.54	1.61	12.49	88.86	86.92	77.62
2007/08	3.50	1.63	12.79	89.41	87.51	78.35
2008/09	3.47	1.66	13.13	89.68	87.88	78.56
2009/10	3.44	1.68	13.35	89.77	88.12	78.72
2010/11	3.40	1.71	13.52	90.16	88.57	79.30
2011/12	3.38	1.74	13.63	90.14	88.61	79.65
2012/13	3.40	1.70	13.68	90.57	89.26	80.79
2013/14	3.29	1.72	13.73	92.27	89.84	83.09

As the definitions of the indicators slightly changed, we can no longer compare like-for-like in our analysis, though the difference is not major.

The numbers for prevalence are obtained from Annex 1 of the QOF report.[19] Data about success rates are obtained from the clinical results tables, available in the same report.

Growth in primary care consultations is reported in table 29. **The survey data suggest that the number of primary care consultations decreased by 1.01% between 2012/13 and 2013/14. Scaled up to account for the population growth, we get a slight positive growth of 0.27%. Finally after taking account of the quality of consultations, the growth in primary care consultations amounts to 0.37%.** This is considerably lower than growth in preceding 2 years.

[19] http://www.hscic.gov.uk/catalogue/PUB12262

Table 29: Growth in primary care consultations

	Number of visits	Population adjusted number of visits	Population and quality adjusted number of visits	Growth rate	Population adjusted growth rate	Population and quality and quality adjusted growth rate
2004/05	265,600	265,600	274,122			
2005/06	283,100	283,100	295,289	6.59%	6.59%	7.15%
2006/07	293,000	293,000	309,501	3.50%	3.50%	4.01%
2007/08	292,500	292,500	311,375	-0.17%	-0.17%	-0.07%
2008/09	300,400	300,400	322,662	2.70%	2.70%	2.79%
2009/10	300,400	282,960	325,487	0.00%	2.82%	2.82%
2010/11	292,567	305,435	319,456	-2.61%	-1.11%	-0.99%
2011/12	303,764	319,661	334,468	3.83%	4.66%	4.70%
2012/13	308,433	327,301	342,667	1.54%	2.39%	2.45%
2013/14	305,328	328,199	343,942	-1.01%	0.27%	0.37%

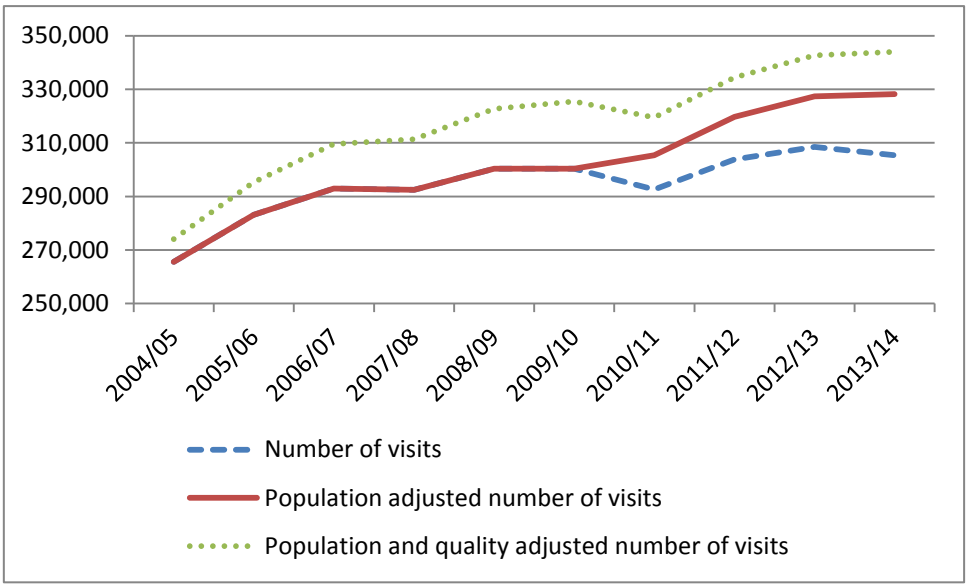


Figure 13: Number of visits in primary care

3.6 Community prescribing

Data about community prescribing are derived from the Prescription Cost Analysis (PCA) system, supplied by the Prescription Pricing Authority via the HSCIC Prescription Drugs Team. The data are based on a full analysis of all prescriptions dispensed in the community, summarised into almost 8,000 categories defined according to chemical composition. The data include information about the Drug code (PropGenLinkCode), Net Ingredient Cost (NIC), Quantity of Drug Dispensed, and Number of Prescription Items. The data are complete and prices are available for all items across the years.

Summary statistics about community prescribing are presented in Table 30. Drugs are categorised according to their chemical composition and the number of categories changes throughout the years, with the peak in 2004/05 (8,779 categories), falling to a low in 2013/14 (7,353 categories).

The 2013/14 data contain information on 7,353 distinct community prescribed drug items representing over a billion prescriptions with a total value/cost of approximately £8.5 billion. This

represents the first yearly increase in total nominal spend since 2010/11. There are 340 new drug items totalling £0.75 million that appear in 2013/14 but not 2012/13. On further inspection many of these new drugs are, in fact, low volume items that have appeared in years other than 2012/13 and have reappeared in 2013/14. There are 690 drug items which appear in 2012/13 but not 2013/14, with a lagged total spend of £4.2 million. There are 18 drugs for which the change in nominal spend is in excess of £10 million.

There are no data items which appear obviously incorrect and we therefore take the data at face value.

Table 30 Community prescribing, summary data

Year	Unique drug codes observed	Total Px	Total Spend (QtPt)	Activity weighted average prescription unit cost (£)
2004/05	8,779	691,948,868	£8,094,174,944	11.7
2005/06	8,535	733,010,929	£8,013,483,226	10.93
2006/07	8,218	762,631,738	£8,250,323,893	10.82
2007/08	8,769	803,297,137	£8,303,500,918	10.34
2008/09	8,276	852,482,281	£8,376,264,432	9.83
2009/10	8,072	897,727,347	£8,621,421,130	9.6
2010/11	7,860	936,743,859	£8,880,735,344	9.48
2011/12	7,856	973,381,568	£8,777,964,802	9.02
2012/13	7,699	1,001,825,994	£8,397,492,181	8.38
2013/14	7,353	1,031,703,347	£8,540,423,964	8.28

From the data we can observe changes in average cost of prescription and in unit (i.e. item) cost over recent years (Table 30). Output and price indices for community prescribing are reported in Table 31. Prices have fallen year-on-year over the whole period, the drop amounting to 1.45% between 2012/13 and 2013/14, a smaller decrease than that recorded in previous years**. The Laspeyres growth in the volume of prescriptions has increased annually, the most recent year-on-year increase amounting to 3.20%, which is broadly average over the last three years.**

Table 31 Community prescribing: price and volume growth

Year	Paasche price ratio	Laspeyres volume ratio
04/05 to 05/06	0.9014	1.0984
05/06 to 06/07	0.9659	1.0659
06/07 to 07/08	0.9376	1.0735
07/08 to 08/09	0.9485	1.0636
08/09 to 09/10	0.9626	1.0693
09/10 to 10/11	0.9833	1.0476
10/11 to 11/12	0.9564	1.0335
11/12 to 12/13	0.9282	1.0306
12/13 to 13/14	0.9855	1.032

Taking the base year as 2004/05, trends in the volume and prices of pharmaceuticals are shown in Figure 14.

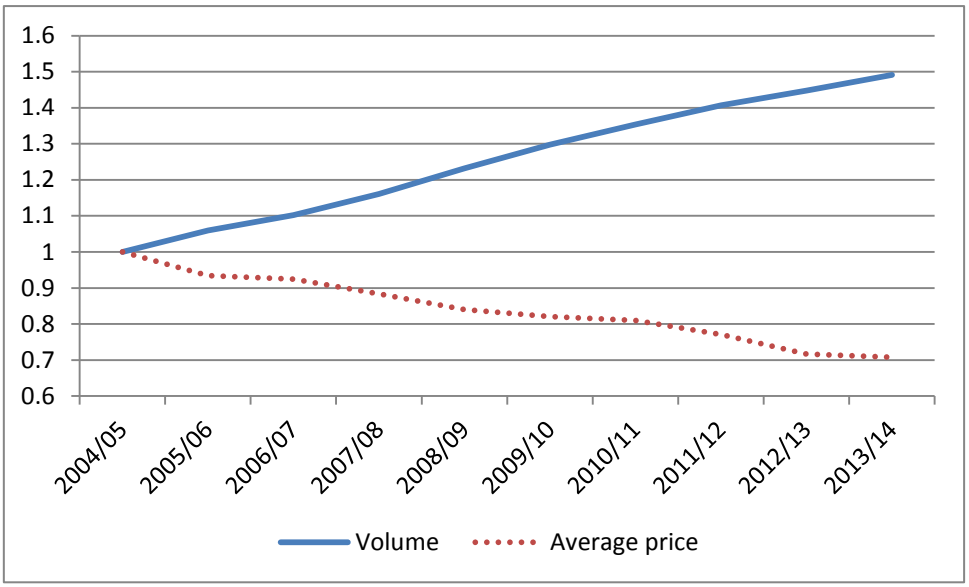


Figure 14: Price and volume changes for community prescribed pharmaceuticals

3.7 Output growth

Output growth is measured by combining activities of different types into a single index, using costs to reflect their values**. This generates our cost-weighted output growth index, which increased by 2.37% between 2012/13 and 2013/14**.

We then re-scale each type of cost-weighted output according to changes in survival rates, health improvements and waiting times. **This generates our quality-adjusted index, which increased by 2.64% between 2012/13 and 2013/14.**

Table 32 Output growth

Output growth	All NHS	
	Cost-weighted growth	Quality adjusted CW growth
2004/05-2005/06	6.53%	7.11%
2005/06-2006/07	5.88%	6.50%
2006/07-2007/08	3.41%	3.66%
2007/08-2008/09	5.34%	5.73%
2008/09-2009/10	3.44%	4.11%
2009/10-2010/11	3.61%	4.57%
2010/11-2011/12	2.38%	3.15%
2011/12-2012/13	2.58%	2.34%
2012/13-2013/14	2.37%	2.64%

3.7.1 *Contribution by settings*

Not all settings contribute equally to the output index. Figure 15 shows the share of overall spend for each of the settings as well as contribution to growth, calculated as share of overall spend multiply by the output growth of the setting. More detailed information on contribution of each setting can be also found in table below.

By far the largest contributor is HES activity, that has a share of 32.61% of totals spend and 33.16% of overall output growth. Other sizeable contributors are primary care, Outpatient activity, community prescribing and community mental health. All other settings contribute less than 6% to total spend or output.

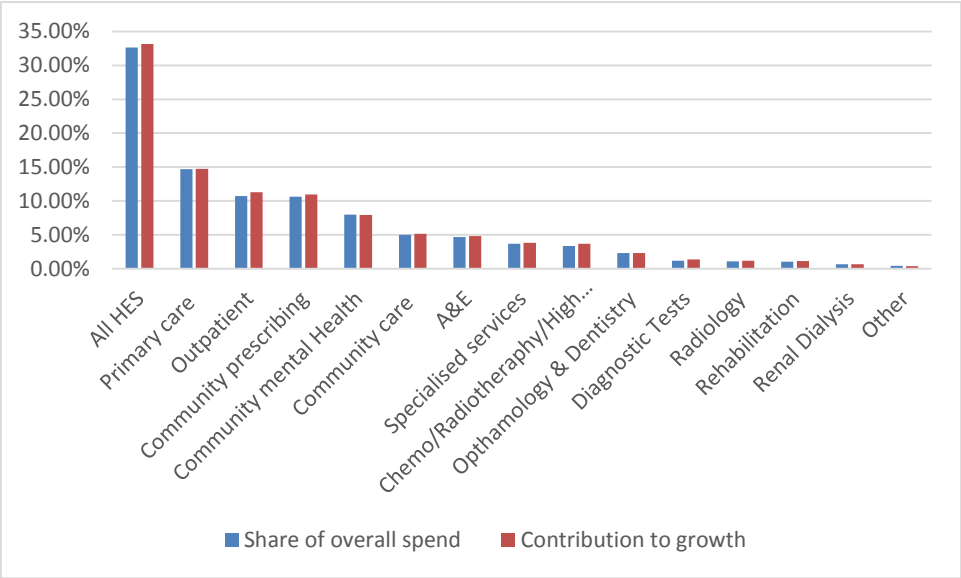


Figure 15: Contribution by setting

Table 33 : Contribution of setting to Growth

Setting	Growth	Qt-1Pt-1	Share of overall spend	Contribution to growth
All HES	1.67%	25,759,729,952	32.61%	33.16%
Primary care	0.37%	11,589,721,226	14.67%	14.73%
Outpatient	5.55%	8,454,528,207	10.70%	11.30%
Community prescribing	3.20%	8,397,492,181	10.63%	10.97%
Community mental Health	-0.45%	6,289,108,108	7.96%	7.93%
Community care	3.15%	3,942,970,966	4.99%	5.15%
A&E	3.04%	3,692,014,018	4.67%	4.82%
Specialised services	3.50%	2,927,444,066	3.71%	3.84%
Chemo/Radiotheraphy/High cost Drugs	9.29%	2,649,282,339	3.35%	3.67%
Opthamology & Dentistry	1.11%	1,814,682,950	2.30%	2.32%
Diagnostic Tests	15.53%	941,490,357	1.19%	1.38%
Radiology	7.50%	859,058,674	1.09%	1.17%
Rehabilitation	12.13%	815,799,140	1.03%	1.16%
Renal Dialysis	0.28%	528,076,698	0.67%	0.67%
Other	-5.50%	323,988,418	0.41%	0.39%
		78,985,387,300		**2.64%**

4. Inputs

Inputs into the health care system consist of:

- Labour, such as doctors, nurses, technicians and managers;
- Intermediate goods and services, such as drugs and clinical supplies;
- Capital, such as buildings and equipment with an asset life of more than a year.

We construct a comprehensive index of input growth, using the workforce data and organisational accounts submitted by NHS organisations. These data are used to quantify the amount of all inputs used in the production of health care provided to NHS patients.

Whereas we only have expenditure data for capital and intermediate inputs, labour data comes from two sources: expenditure data as well as staff numbers from the Electronic Staff Record (ESR). We explore the consequences of using these alternative data sources about labour input. We report estimates for two different formulations of the input index. Our mixed index uses information about labour inputs recorded in the ESR; our indirect method uses expenditure data only.

4.1 Direct labour

Prior to 2007/08, we used data from the Workforce Census to count the number of staff working in the NHS. But, since it was made available in 2007/08, we have used the ESR data to calculate growth in labour inputs.[20] These data are obtained from the NHS iView database https://iview.ic.nhs.uk/ which draws data directly from the ESR, and combined Payroll and Human Resources system for the NHS. The data contain numbers of full time equivalent (FTEs) staff and earnings by over 580 different occupational groups for all staff employed in the NHS, by organisation.[21] Where 5 or fewer staff members are employed in a particular staff group, the organisation randomly reports either 5 or 0. For this reason, the reported total number of staff constructed using the ESR source data differs from the aggregated figures published by the HSCIC.[22]

Data on staff earnings come from a separate dataset, also provided by HSCIC, which includes all earnings data submitted by NHS organisations for staff paid directly by the NHS. This dataset contains average earnings by occupational group. The following fields are available:[23]

- Basic Pay Per FTE 12 Month
- Total Earnings 12 Month
- Basic Pay 12 Month
- Non Basic Pay 12 Month

In our calculation we sum together Basic Pay Per FTE 12 Month and non-basic pay to get total earnings for a particular staff group. As non-basic pay is no longer reported by FTEs, but only by headcount, we multiply that number first by an FTE/headcount ratio to get the equivalent FTE number (as advised by HSCIC). With the earnings information, we observe the change in associated cost by different occupational codes and organisation types.

[20] We excluded one organisation from the ESR data reported in 2011/12 that had not appeared in previous years.

[21] We drop ESR returns made by private providers, NHS Arm's-length bodies, Special Health Authorities and other NHS bodies that report to the ESR but do not fall in the included categories (e.g. Sussex Health Informatics Service (YDD81))

[22] https://iview.hscic.gov.uk/DomainInfo/WorkforceMonthly. Note that HSCIC does publish small numbers in some of their workforce data releases, for examples visit http://www.hscic.gov.uk/catalogue/PUB13776/comp-of-neur-data-work_V2.xlsx

[23] In the past we had information on total earnings per month, without separation in basic/non-basic

For three different occupational codes, we observe absolute changes in expenditure in excess of £50m between 2012/13 and 2013/14. This is due to a substantial increase or decrease in the number of staff in these particular categories.

Table 34: Occupational codes with large change in expenditure

Occupational code	Code description	Change in #FTEs	Change in expenditure
N6A	Other 1st level Acute, elderly & general	3,768	£162,416,637
G2A	Clerical & administrative Central functions	(2,102)	-£61,612,949
H1A	HCA Acute, elderly, general	2,573	£57,514,377

Several new codes were adopted in 2013/14. As stated in the NHS occupation codes guide,[24] staff from the Major Staff Group (MSG) T (Scientific, Therapeutic and Technical Staff) is now reclassified into MSG U (Healthcare Scientists). This reclassification happened towards the end of 2013/14: in 2013/14, 3,456 people were classified under the U code and 35,616 under the T code. For reporting purposes we merged both groups into one. We do not have any information about earnings for staff in group U, and therefore imputed a value of average earnings for staff in MSG T.

The number of organisations captured in the ESR changes every year (Table 35), not least due to the large NHS re-organisation. There are additional changes due to the creation of new organisations, discontinuation of others, and mergers within existing categories. However, the difference is also due to the increasing scope of organisations that report ESR data.

Table 35 Number of reporting entities by organisation type

Organisation type	2010/11	2011/12	2012/13	2013/14
CCGs	0	0	9	152
CSUs	0	0	0	24
NHS England	0	0	1	1
Non-geographical staff[a]	0	1	1	1
PCTs	147	142	132	40
SHA	10	10	10	2
NHS Trusts	248	260	260	251

[a] Non-Geographic Central Staff; code AHO

Table 36 shows expenditure by organisational type as determined by the summed product of staff group FTEs and average earnings. Table 36 also illustrates the impact that the NHS re-organisation has had on the apparent distribution of labour expenditure over time. For example, in 2010/11, NHS Trusts accounted for approximately 83% of expenditure captured by the ESR. In 2013/14, this had increased to approximately 97%. This is due to the fact that the labour expenditure of PCTs and SHAs greatly exceeded the expenditure of the organisations that have replaced them: NHS England, the CCGs and CSUs.

[24] http://www.hscic.gov.uk/article/2268/NHS-Occupation-Codes

Table 36: Expenditure on labour in current prices (£m)

Organisation type	2010/11	2011/12	2012/13	2013/14
CCGs	£0	£0	£6.7	£433.5
CSUs	£0	£0	£0	£318.1
NHS England	£0	£0	£0.75	£221.4
Non-geographical staff	£0	£157.1	£142.6	£76.2
PCTs	£5,822.3	£3,742.2	£1,329.0	£89.2
SHA	£133.3	£113.7	£109.6	£0.4
NHS Trusts	£28,808.5	£31,761.3	£33,753.3	£34,509.6

In part, this may be due to coverage issues that have arisen over the re-organisation. For example, we know that there were 211 CCGs operating in 2013/14 but Table 35 shows that only 152 CCGs reported staff data in the ESR. The inconsistent coverage over time raises some issues regarding the use of ESR as a measure of labour input. For example, whilst not all trusts have used the ESR (e.g. Isle of Wight), it has previously been assumed that the growth in staffing observed by trusts within the ESR is representative of that in trusts not submitting ESR data. However when there are new types of organisation altogether this assumption may be untenable.

We are primarily concerned that the decrease in PCTs reporting between 2012/13 and 2013/14 may be a function of lower coverage as well as genuinely reduced labour input. Conversely, the increases reported by CCGs may be a function of both a genuine increase and changing coverage over time. We note that the CCGs that reported data in 2013/14 tended to be larger (serving an almost 40% higher population on average), and with older populations on average, than those that did not report.

The number of NHS staff, measured as Full Time Equivalents (FTEs), is reported in Table 37. Figure 16 presented growth in labour input from a base of 2007/8. Numbers of GPs and practice staff are taken from the Workforce Census. The method used to count practice staff was revised in 2011/12, though the counts for both methods are available for this year. We do not use the numbers of GPs and practice staff directly in our calculation of input growth but use expenditure data instead.

Table 37 NHS Staff numbers

	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14
GPs (a)	31,021	32,855	33,384	33,730	34,043	36,085	35,243	35,319	35,871	36,294
GP Practice staff	69,140	72,006	72,990	75,085	73,292	72,153	73,306			
GP Practice staff – new method							82,802	84,609	85,546	87,114
Medical staff (b)	78,462	82,568	85,975	84,811	90,460	93,393	95,531	99,331	100,878	100,797
Ambulance staff				21,149	23,084	24,489	25,056	24,908	24,566	24,757
Administration and Estates staff				237,264	243,018	262,479	263,723	250,539	242,980	239,359
Health care assistants and other support staff				101,114	106,406	112,710	114,786	116,643	116,018	119,138
Nursing, midwifery and health visiting staff and learners				366,520	372,132	379,841	380,114	377,948	363,781	369,246
Scientific, therapeutic and technical staff and healthcare scientists				141,754	150,056	159,538	165,454	168,750	164,312	165,683
Unknown and Non-funded staff				4,327	3,595	3,462	3,351	3,055	2,652	2,423
Professionally qualified clinical staff	412,013	425,044	425,983							
Support to clinical staff	271,347	278,994	273,202							
NHS infrastructure support staff	178,530	186,510	178,230							
Volume Index FTE		3.60%	-0.76%	-0.37%	2.85%	4.39%	1.91%	-0.43%	-2.11%	0.72%
Labour Index		3.44%	0.64%	0.64%	4.22%	4.55%	1.29%	-0.24%	-1.95%	0.38%

Notes: (a) Data for GPs and GP practice staff is not available from ESR; Workforce Census data is used instead; there were also changes in counting of GP Practice staff therefore 2010/11 and 2011/12 years are not comparable to previous years. This includes GPs and GP trainees working in hospital http://www.hscic.gov.uk/media/9377/NHS-Occupation-Code-Manual-v10/pdf/NHS_Occupation_Code_Manual_Ver_10.pdf
(b) FTE data prior to 2007/08 is taken from the Workforce Census data. FTE data from 2007/08 onwards is taken from organisational returns of Electronic Staff Records. When there are 5 or less people employed in an occupational group, organisations report either 5 or 0; these totals therefore will differ from those derived from national level data.

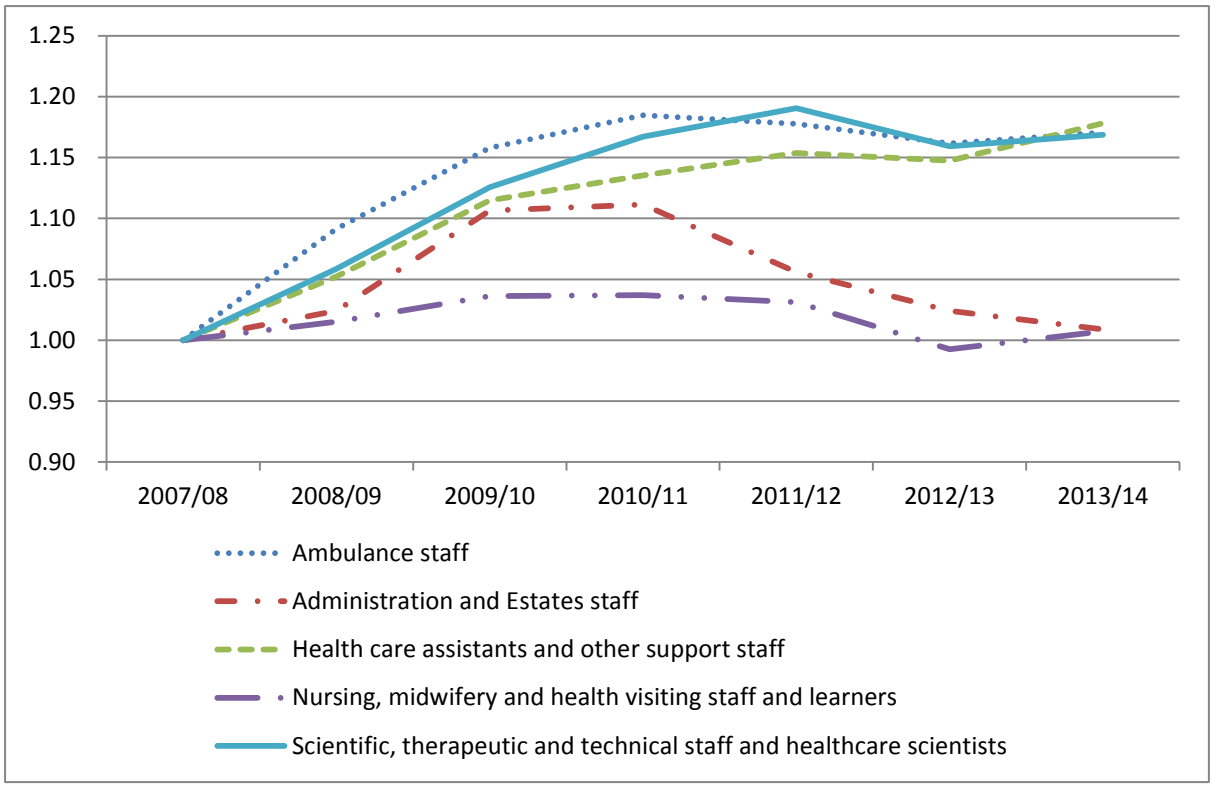


Figure 16: Growth in non-medical staff

Table 38: Growth in direct labour

Year	Nominal Expenditure Growth		Laspeyres Volume Growth	
	All*	Trusts	All*	Trusts
2007/08 to 2008/09	7.61%	7.21%	4.14%	3.77%
2008/09 to 2009/10	7.03%	6.55%	4.54%	4.15%
2009/10 to 2010/11	2.62%	3.70%	1.42%	2.95%
2010/11 to 2011/12	2.91%	10.25%	0.1%	7.26%
2011/12 to 2012/13	-1.21%	6.27%	-1.97%	5.5%
2012/13 to 2013/14	0.87%	2.24%	0.38%	1.71%

* all organisations reporting to ESR except independent providers; arms-length bodies and special health authorities

Table 38 shows the growth in nominal expenditure and the Laspeyres input growth over time by trusts and by all included organisations (i.e. Trusts plus PCTs, CCGs, CSUs, NHS England, SHAs and the non-geographical category). As expected, due to wage inflation, the Laspeyres input growth is always smaller than the nominal growth. Of note, however, is the consistently positive growth in the trust setting and, in particular, the large growth from 2010/11 to 2012/13 despite austerity. This has been attributed to the transfer of PCT staff to trusts via the 'Transforming Community Services' initiative.[25]

At 0.38%, the growth rate for labour in 2012/13 – 2013/14 is positive but relatively small. *A priori* expectations may have been that this figure would be larger because of the impact on staffing levels in trusts following the Keogh and Berwick reports, CQC inspections and the Francis Inquiry, this dealing with poor level of care in the Mid Staffordshire Trust and advising that higher staffing ratios be adopted. The impact of the various staffing and quality reports is thought to have impacted only on the last quarter of the financial year and, therefore, would only have a limited impact on annual labour resource use. As shown in Figure 17, the number of staff started rising only several months

[25] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/229996/Annual_Report.pdf

after the publication of the Francis report, the consequences of which may be more visible in 2014/15.

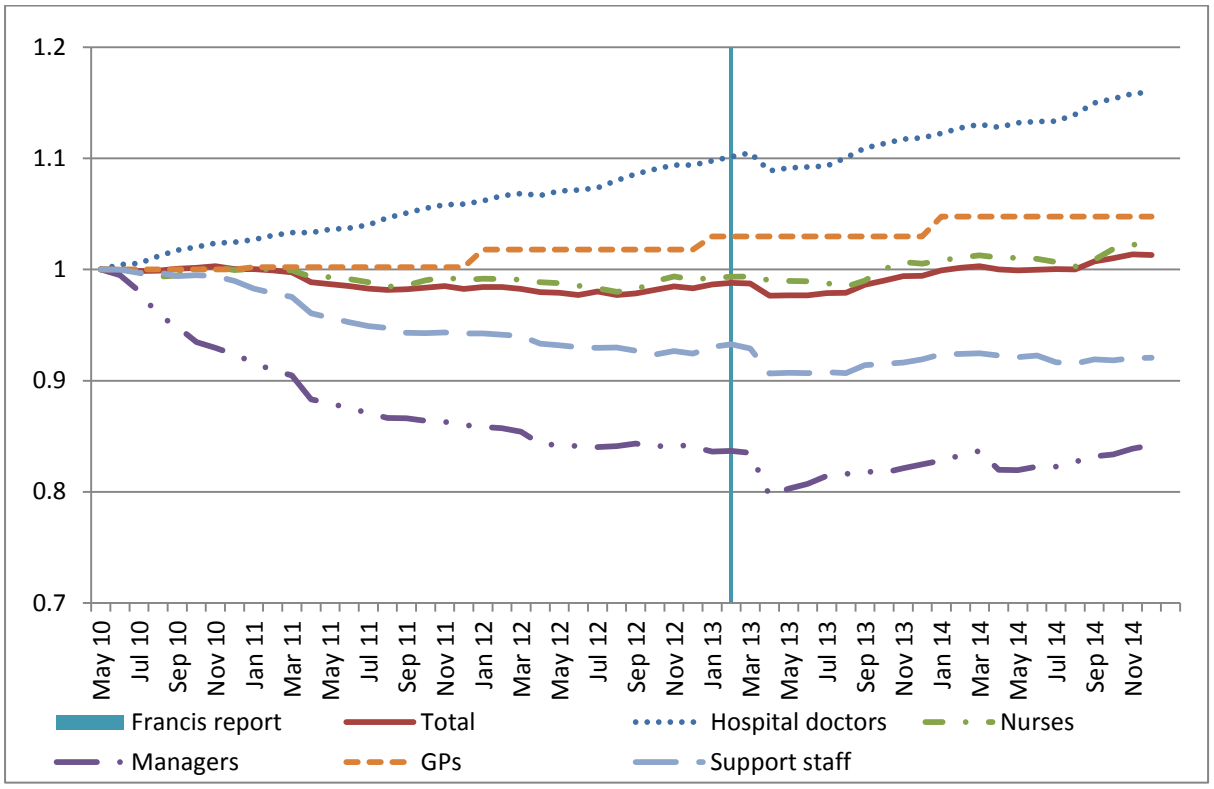


Figure 17: Changes in number of FTE in different categories by month

4.2 Expenditure data

The source of expenditure data has changed over time and by type of organisation, as summarised in Table 39. Data for Foundation Trusts are derived from the Consolidated NHS Financial Trust Accounts, the format of which has remained unchanged over the full period. These accounts are less detailed than Trust Financial Returns (TFRs), which were reported by NHS trusts, PCTs and SHAs up to and including 2011/12. These provided a detailed breakdown of expenditure on different types of NHS and agency staff, intermediate inputs and capital items.

The TFRs were discontinued in 2011/12 for PCTs and SHAs. For residual expenditure by these disbanding organisations we have relied on aggregated information as reported in the DH Annual Report and Accounts.

For NHS Trusts, TFRs were replaced with Financial Monitoring and Accounts, although both reporting systems were used in 2011/12. The Financial Monitoring and Accounts are much less detailed than the TFRs, reporting information for very broad categories of input type, making it no longer possible to report time series for specific input types. For instance, it is not possible to identify expenditure by NHS Trusts on agency staff from this information.[26] Instead, we have used data provided by the Department of Health to identify recent expenditure on agency staff.

[26] http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2014-10-22/211600/

Table 39 Source of financial information

	2004/5-2011/12	2011/12-2012/13	2012/13-2013/14
Foundation Trusts	Consolidated NHS Financial Trusts Accounts		
NHS Trusts	Trust Financial Returns	Financial Monitoring and Accounts	
PCT/SHAs	PCT/SHA Financial Returns	DH Annual Reports and Accounts	N/A
NHS England/CSUs/CCGs	N/A		DH Annual Reports and Accounts

Other than loss of detail, the more aggregated data has two major implications for the construction of the input index:

1. Rather than input-specific price deflators, we now have to apply deflators for each aggregated input category. This may generate inaccuracy in distinguishing the contributions of changes in volume and prices to expenditure growth.

2. The detail in the financial returns made it possible to account for utilisation of different types of capital in each period, albeit subject to various assumptions about asset life and depreciation (Street and Ward, 2009). The annual accounts, however, do not identify all items of capital. This makes it impossible to ascertain how much has been spent on capital in each period, let alone how much of the capital acquired has been utilised.

The financial reporting lines designated as intermediate and capital items in the most recent financial data are listed in Table 40 for NHS Trusts and PCTs/SHAs.

Table 40 Intermediate and capital items

	Intermediates	Capital
NHS Trusts *Source:* *Financial Monitoring & Accounts*	Services from Other NHS Trusts Services from PCTs Services from Other NHS Bodies Services from Foundation Trusts Purchase of Healthcare from Non-NHS Bodies Supplies & Services - Clinical Supplies & Services - General Consultancy Services Transport Audit fees Other Auditors Remuneration Clinical Negligence Research & Development (excluding staff costs) Education & Training Establishment Other	Premises Impairments & Reversals of Receivables Inventories write downs Depreciation Amortisation Impairments & Reversals of Property, Plant & Equipment Impairments & Reversals of Intangible Assets Impairments & Reversals of Financial Assets Impairments & Reversals for Non Current Assets held for sale Impairments & Reversals for Investment Properties
PCTs/SHAs/CCGs/NHS England Group *Source:* *DH Annual Report & Accounts*	Consultancy Services Transport Clinical Negligence Costs Establishment Education, Training & Conferences Supplies & Services - Clinical Supplies & Services - General Inventories consumed Research & Development Expenditure Other	Premises Impairment of Receivables Rentals under operating leases Depreciation Amortisation Impairments & reversals

4.2.1 *Input use derived from expenditure data*

Table 41 presents expenditure reported by PCTs, CCGs and NHS England Group. We can see that the expenditure by PCTs had a huge drop in 2011/12, due to reorganisation of the NHS and transfer of staff from PCTs to Trusts. PCTs officially ceased to exist in 2013/14; their activity was partly taken over by CCGs, as well as by CSUs (Commissioning Support Units) and NHS England, together forming the NHS England Group.

It is not clear which activity was taken over by which organisation. Unlike PCTs CCGs do not perform clinical activity and is also unclear how other new organisations share the work previously done by PCTs and SHAs.

Table 41 Current expenditure by PCTs (£000), CCGs and NHS England Group

	Current	Labour	Intermediates	Capital
PCTs	2007/08	6,701,228	2,617,114	1,174,841
	2008/09	7,478,953	2,526,610	1,247,997
	2009/10	8,230,341	2,623,459	1,703,974
	2010/11	7,175,399	2,638,638	1,171,813
	2011/12	2,328,314	2,052,029	892,604
	2011/12*	2,358,373	860,860	1,721,795
	2012/13*	1,938,770	885,265	1,814,809
CCGs	2013/14*	658,156	613,742	356,272
NHS England Group	2013/14*	1,529,067	1,522,637	667,386

Note: * Data prior to 2011/12 from Financial Returns and from 2011/12 data from DH Annual Report and Accounts. Intermediate and capital items are identified differently in each source

As we can see from Table 41 and from Table 42, **expenditure from PCTs was much higher than expenditure by CCGs, or even by the whole NHS England Group.**

Table 42: Expenditure for PCTs, CCGs and NHS England Group

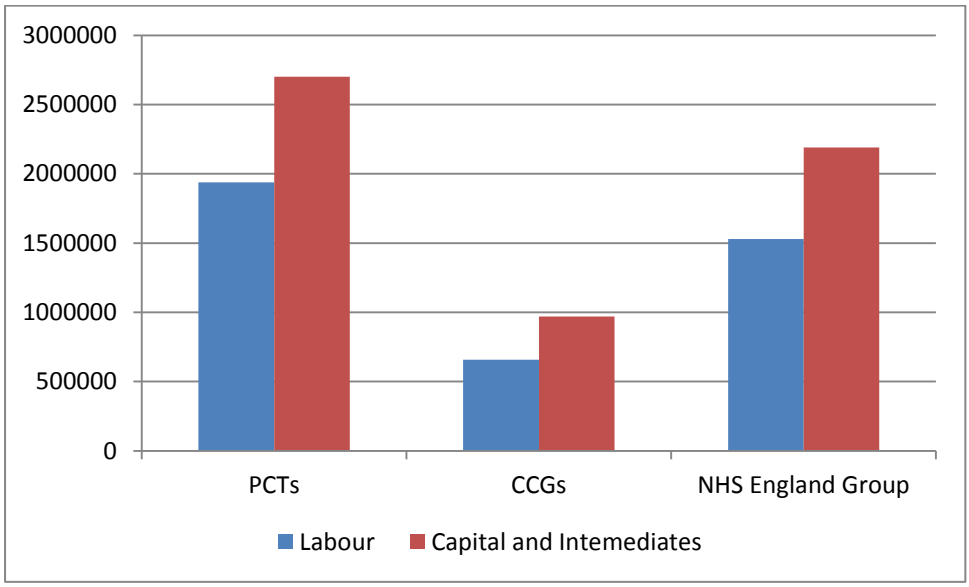


Table 43 shows the expenditure for labour, intermediates and capital for trusts and foundation trusts. We observe a steady increase across all the categories. **In current terms, labour increased by 3.6%. We also observe large increases in expenditure for intermediates and capital, amounting to 7.2% and 6.8% respectively.**

Table 43 Current expenditure by NHS Trusts (£000)

Current	Labour	Intermediates	Capital
2007/08	30,884,556	10,140,836	6,452,630
2008/09	33,435,219	11,322,441	6,340,019
2009/10	35,983,781	12,115,273	6,529,977
2010/11	38,222,951	12,961,217	6,839,898
2011/12	42,647,889	14,941,588	7,278,435
2011/12*	42,701,684	17,477,370	12,097,485
2012/13*	43,797,935	19,681,855	12,377,259
2013/14*	45,360,562	21,108,612	13,217,703

Note: * For NHS Trusts, data from prior to 2011/12 from Financial Returns and from 2011/12 data from Financial Monitoring and Accounts. Intermediate and capital items are identified differently in each source

The use of agency staff is subject to considerable year-on-year variation, as shown in Figure 18. The substantial increase of 23% between 2012/13 and 2013/14 will contribute to increased overall input growth.

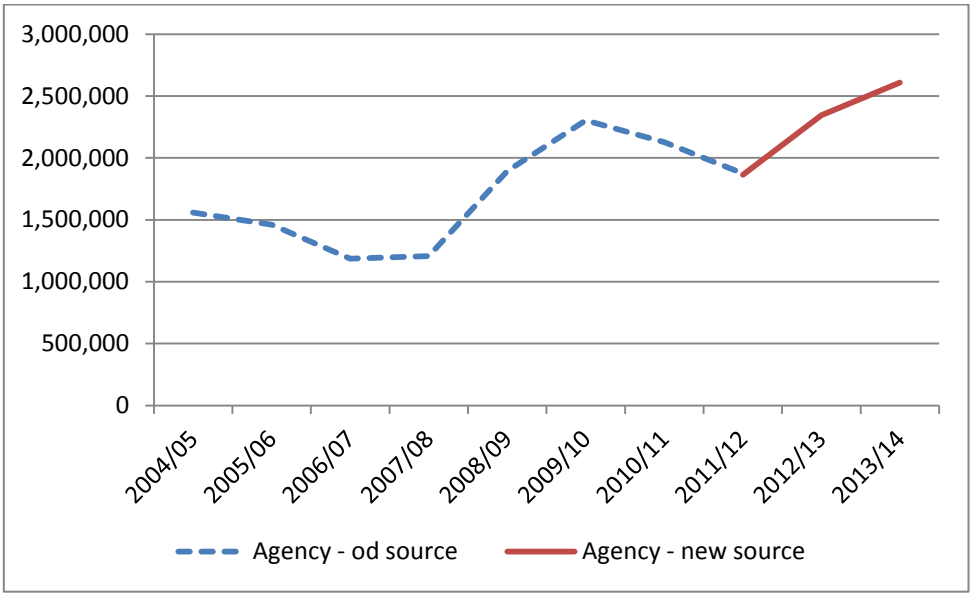


Figure 18: Trends in use of agency staff

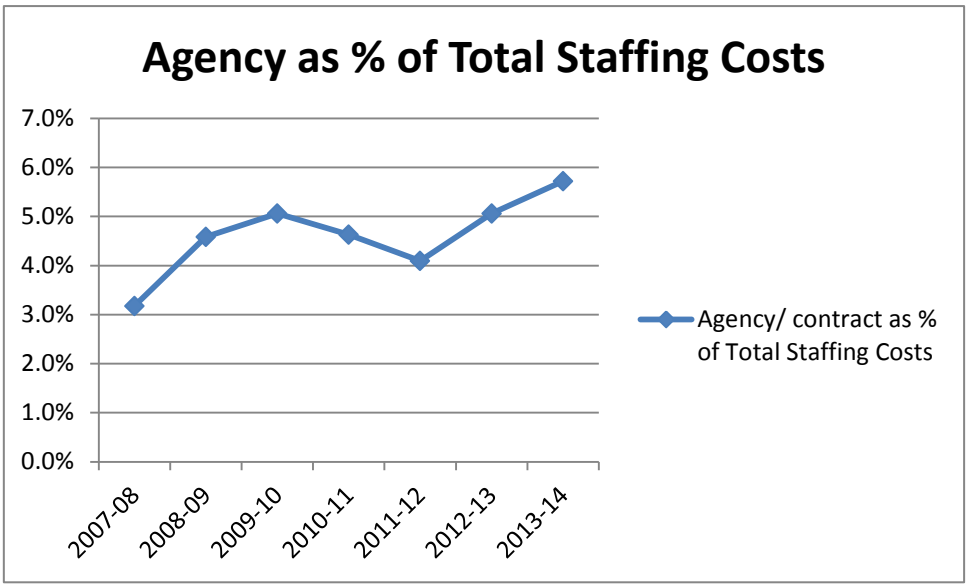


Figure 19: Agency staff as a percentage of total staffing costs

Table 44 presents current expenditures for the total NHS. In 2013/14 we do not include spend for DH admin. This is due to the restructuring of the NHS and changes to the DH responsibilities. In order to compare like-with-like, we omitted this cost in both 2012/13 and 2013/14 in our calculations of input growth between these years.

Table 44 Total NHS current expenditure (£000)

Current	NHS Staff	Agency	Intermediate	Capital	Prescribing	Primary Care	DH Admin	TOTAL
2004/05	31,334,252	1,557,282	8,757,990	5,115,514	8,094,175	9,569,836	278,000	64,707,050
2005/06	33,926,746	1,459,936	10,271,344	5,839,664	8,013,483	11,162,141	262,000	70,935,314
2006/07	35,177,509	1,185,244	11,378,727	6,568,363	8,250,324	11,209,422	229,000	73,998,589
2007/08	36,561,167	1,207,654	13,036,200	7,784,592	8,303,501	11,697,639	226,000	78,816,753
2008/09	39,264,185	1,895,423	13,991,803	7,426,031	8,376,264	12,074,672	242,958	83,271,336
2009/10	42,104,673	2,302,578	14,911,074	7,635,390	8,621,421	12,683,418	241,608	88,500,162
2010/11	43,513,839	2,127,889	16,077,609	8,025,361	8,880,735	12,962,081	212,245	91,799,759
2011/12	43,360,622	1,872,598	17,221,673	8,265,079	8,777,965	13,250,874	453,000	93,201,811
2011/12*	43,457,477	1,862,385	19,154,991	13,892,358	8,777,965	13,250,874	453,000	100,849,049
2012/13*	43,654,591	2,345,552	21,442,537	14,273,017	8,397,492	13,419,803	457,000	103,989,992
2013/14*	44,282,582	2,607,047	22,631,246	13,885,089	8,540,424	13,294,670	n/a[27]	105,241,061

* For NHS Trusts, data from prior to 2011/12 from Financial Returns and from 2011/12 onwards data from Financial Monitoring and Accounts. Agency costs, intermediate and capital items are identified differently in each source

[27] For calculating input growth between years 2012/13 and 2013/14 we did not include the costs of DH Admin.

4.3 Input growth

Our measures of input growth are reported in Table 45, differentiated according to the use of the mixed or indirect index. Estimates of input growth have generally been higher if using the mixed rather than the indirect input index. **However, this is not the case for 2012/13 – 2013/14, where the mixed index suggests a growth rate of 0.43% while the indirect index suggests that input growth amounted to 0.55%.** This is because labour growth in the most recent pair of years appears lower if using data derived from the ESR instead of the accounts.

Previously we have expressed a preference for the indirect measure, believing that direct measurement of labour input using workforce data is preferable to indirect measurement using expenditure data. However, due to concerns about the coverage of CCGs in the ESR, labour inputs may be undercounted. Consequently, the indirect measure may more closely capture growth in labour inputs in the most recent pair of years. Reassuringly, though, the discrepancy between the two measures is small, with a difference of just 0.12%.

Table 45 Input growth

Input Growth	All NHS	
	Mixed	Indirect
2004/05 – 2005/06	7.19%	7.10%
2005/06 – 2006/07	1.92%	1.36%
2006/07 – 2007/08	3.88%	3.70%
2007/08 – 2008/09	4.23%	4.24%
2008/09 – 2009/10	5.43%	5.83%
2009/10 – 2010/11	1.33%	0.80%
2010/11 – 2011/12	1.00%	0.75%
2011/12 – 2012/13	1.98%	2.63%
2012/12 – 2013/14	0.43%	0.55%

5. Productivity growth

Year-on-year quality adjusted productivity growth figures over the pair of years from 2004/05 – 2013/14 are provided in Table 46. We find that, if we use the mixed approach to capture input growth, productivity growth for the last three pairs of years has been positive, although the growth rate has been declining over time. **This conclusion is sensitive to how NHS staff inputs are measured: productivity growth for 2012/13 – 2013/14 is estimated to have been 2.20% based on the mixed method, and 2.07% if based on the indirect method.**

Table 46 Productivity growth year-on-year

Productivity growth	All NHS	
	Mixed	Indirect
2004/05 – 2005/06	-0.07%	0.01%
2005/06 – 2006/07	4.50%	5.07%
2006/07 – 2007/08	-0.21%	-0.04%
2007/08 – 2008/09	1.44%	1.43%
2008/09 – 2009/10	-1.25%	-1.63%
2009/10 – 2010/11	3.21%	3.74%
2010/11 – 2011/12	2.13%	2.38%
2011/12 – 2012/13	0.36%	-0.28%
2012/13 – 2013/14	2.20%	2.07%

As can be observed in Figure 20, both input and output series seem to be on a downward trend, with apparent lags in latter. Where the output line is above the input line the productivity growth is positive, in other cases it is negative.

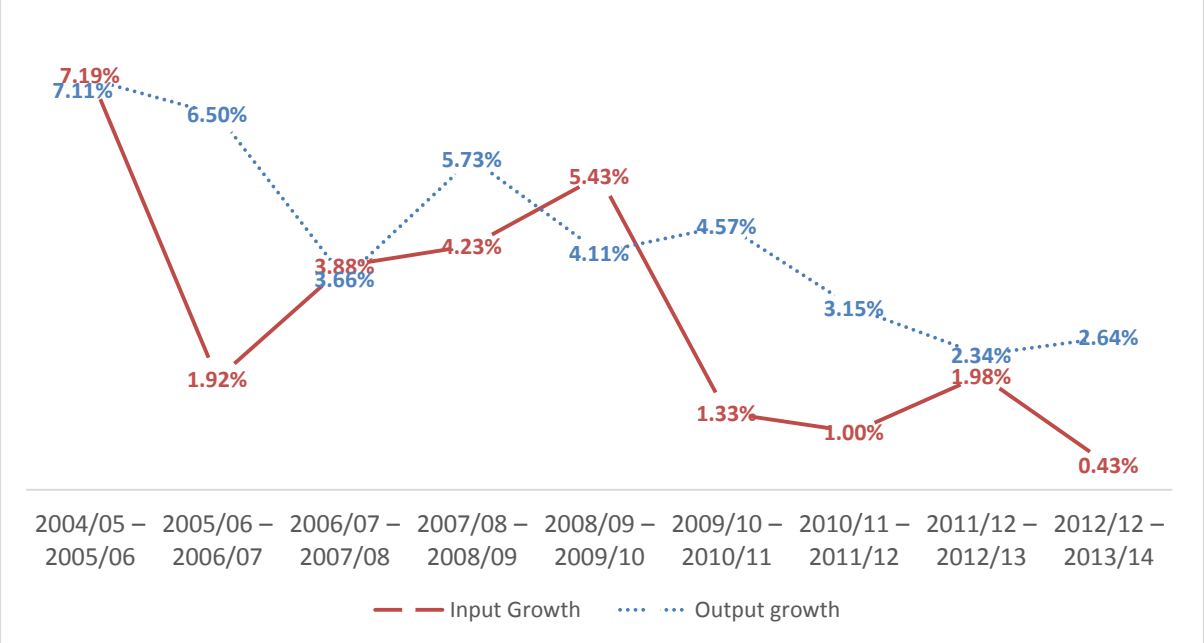


Figure 20: Input and output growth

Figure 21 present the input, output and productivity indices over time. We can observe very slow growth in the input series which drives the productivity upwards.

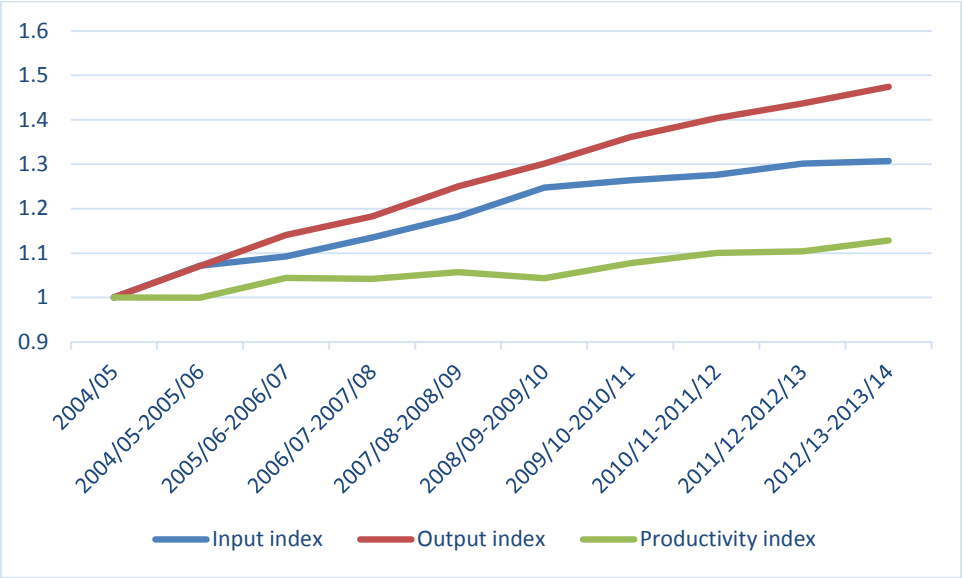


Figure 21 Trends in input, output and productivity growth

6. Conclusions

Total NHS productivity growth between 2012/13 and 2013/14 was 2.20% under the 'mixed' method of calculation and 2.07% under the 'indirect' measure. This represents a substantial rise on the 0.36% and -0.28% estimates recorded for the previous pair of financial years, and is the fourth consecutive period of year-on-year growth.

Quality adjusted output growth between 2012/13 and 2013/14 amounted to 2.64% for the NHS as a whole. This value is similar to, but above, the 2011/12 to 2012/13 quality adjusted growth figure of 2.34%. In the overall series of output growth figures, from 2004/05–2005/06 to 2012/13–2013/14, it represents the second lowest output growth, and is lower than the average annual growth.

The main setting in which output growth occurred was non-admitted patient care. Non-admitted output growth as measured by reference costs is 3.70% and outpatient growth, as measured by HES, is 5.55%. In comparison, inpatient output growth as measured by HES is only 1.67%. There was a reduction in mental health activity: within the general category of HES measured inpatient output we note an inpatient mental activity growth of -5.36% and non-hospital growth of -0.45%

Unlike 2011/12–2012/13, the impact of quality adjustment in 2012/13 – 2013/14 has been to increase the measure of output growth. This is due to decreasing waiting times and an improvement in survival rates per HRG between these two years. For example, cost-weighted inpatient output growth is just 0.85%, but 1.67% when adjusted for quality improvements. Though the relative impact of quality adjustment may seem large, the absolute magnitude of the impact of quality adjustment is similar to previous years

Our indirect measure of input growth indicates a growth of 0.55% and our mixed measure (using the direct measure of labour) is 0.43%. Our usual base case measure uses the mixed method, as it generally recommended to use direct measures where possible. However, concerns about the coverage of the Electronic Staff Record, used to populate our direct measure of labour and, specifically, probable incomplete coverage of the new CCGs suggests that it might be more accurate to measure labour input using expenditure data over 2012/13-2013/14. Reassuringly, both measures of input growth are similar and there are no substantive differences between one or the other.

Regardless of which measure is used, input growth is low and represents the lowest growth rate in our series. The main reason for this has been the replacement of PCTs by the new organisations forming the NHS England Group (CCGs, CSUs, etc.) For example, although not completely coterminous, CCG expenditure in 2013/14 was approximately 13% of PCT nominal expenditure in 2008/09 (see table 40). Even allowing for the steady decline in PCT expenditure since the announcement of the planned reorganisation, the NHS England group expenditure in 2013/14 is still significantly below the equivalent organisational expenditure in 2012/13, with a negative growth measure of -21.25%. Measurement of trust input growth, in contrast, remains relatively high, measured at 3.64%. Perhaps surprisingly this is not attributable to labour growth motivated by the Francis Inquiry, Berwick and Keogh reports and CQC inspections, but more a function of growth in intermediates and capital expenditure.

Overall, we estimate quality-adjusted productivity growth to be 2.07% using our indirect measure of input growth. This is primarily a reflection of very low input growth generated by switching from relatively expensive PCTs (and SHAs) to a less resource intensive NHS England Group (predominantly CCGs). The measure of productivity using our mixed measure of input growth is 2.20% but, as mentioned, probably represents an over-estimate due to incomplete coverage of CCG labour usage.

As usual, some caveats with our measurement exist, two of which are worth further note.

Firstly, data on primary care are still problematic as there are no reliable comprehensive data sources for such data. We continue to apply our standard approach of using survey data to estimate activity. Whilst primary care represents a sizable component of output (approximately 14%) and is therefore an important component of the measurement, use of survey data does not have any obvious sources of bias that may over- or under-estimate our estimate. As a result, it is difficult to predict what effect better primary-care data may have on our estimates.

Secondly the large-scale reorganisation created by the 2012 Health and Social Care Act and the replacement of SHAs and PCTs by NHS England, CSUs and CCGs may have created some issues with measurement. In particular, we have some reservations about the extent of coverage of both inputs and outputs for the outgoing and incoming organisations. We strongly suspect, for example, that ESR coverage of CCG labour use is incomplete. As a response to this, we have switched our preferred measure of input measurement for this particular report from mixed to indirect, as we believe the NHS accounts data have complete coverage.

There may, however, also be issues on the output side which are less easily accommodated. For example, there may have been some PCT activity in 2012/13 which is not recorded in reference costs. If so, then the output measurement for 2012/13 would be under-estimated. As PCTs did not officially exist in 2013/14, then any unrecorded output is likely to be less than in 2012/13 – i.e. if there is an issue of mismeasurement of PCT output, it is likely to be greater in 2012/13 than in 2013/14. The consequence of this would be an over-estimation of output growth between 2012/13 and 2013/14. However, whilst it is not possible to provide an alternative source of measurement as with the input data, we have no evidence to suggest that this is a particularly major issue. For example, HES data, which should not have been affected, indicates very little PCT activity in 2012/13. Furthermore, the productivity measure for 2012/13 to 2013/14 is driven by very low growth in inputs, a measurement that we are confident is not biased by the re-organisation.

In addition to our usual whole-NHS measurement we have also included a measurement for trusts only, which is contained in the appendix. For trusts we find a quality-adjusted output growth of 3.07% and a mixed method input growth of 3.60%, leading to a small but negative productivity growth of -0.51%.

In conclusion, we find our preferred measurement of input and output growth for the whole NHS England Group for 2012/13 to 2013/14 to represent a fourth consecutive measure of positive productivity growth, and a fairly substantial increase from 2011/12 to 2012/13, where productivity growth was closer to zero. As discussed, recent positive growth is partly a function of historically low output growth but mainly a reflection of low input growth due to the replacement of PCTs and SHAs by a less resource intensive NHS England Group.

7. References

Appleby J. et al 2014. *The NHS Productivity Challenge: Experience from the Front Line* http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/the-nhs-productivity-challenge-kingsfund-may14.pdf, London, The King's Fund.

Atkinson T. 2010. *Measuring Health Output, Productivity and Equity,* London, Office of Health Economics.

Balk BM. 2010. Direct and chained indices: a review of two paradigms *In:* Diewert WE, Balk BM, Fixler D, Fox KJ, Nakamura AO. (eds.) *Price and Productivity Measurement: Volume 6 -- Index Number Theory.* Trafford Press.

Berwick DC. 2013. *National Advisory Group on the Safety of Patients in England. A promise to learn—a commitment to act.* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226703/Berwick_Report.pdf, London, Department of Health.

Bojke C, Castelli A, Goudie R, Street A, Ward P. 2012. *Productivity of the English National Health Service 2003-4 to 2009-10,* York, Centre for Health Economics Research Paper 76, University of York

Bojke C, Castelli A, Grasic K, Street A. 2015. Productivity of the English NHS: 2012/13 update.

Bojke C, Castelli A, Gražič K, Street A. 2014. *Productivity of the English National Health Service from 2004/5: updated to 2011/12,* York, Centre for Health Economics Research Paper 94, University of York

Castelli A, Dawson D, Gravelle H, Jacobs R, Kind P, Loveridge P, Martin S, O'Mahony M, Stevens P, Stokes L, Street A, Weale M. 2007. A new approach to measuring health system output and productivity. *National Institute Economic Review,* 200**,** 105-117.

De Boer S, Van Dalen J, Verbiest P. 1997. *Chain indices in the national accounts: the Dutch experience,* Heerlen, Netherlands, Statistics Netherlands.

Department of Health 2012. *Reference Costs 2011-12,* Leeds, NHS Information Centre.

Department of Health 2014. *NHS reference costs collection guidance for 2013 to 2014,* Leeds, Department of Health.

Diewert WE, Balk BM, Fixler D, Fox KJ, Nakamura AO. 2010. *Price and Productivity Measurement: Volume 6 -- Index Number Theory*, Trafford Press.

Eurostat 2001. *Handbook on Price and Volume Measures in National Accounts,* Luxembourg, Office of Official Publications of the European Communities.

Fenty J, Coupland C, Hippisley-Cox J, Gravelle H. 2006. *Determinants of consultation rates over time: Implications for estimating the national volume of consultations.* Nottingham, Qresearch University of Nottingham.

Francis R. (Chair) 2010. *The Mid Staffordshire NHS Foundation Trust Inquiry. Final report of the independent inquiry into care provided by Mid Staffordshire NHS Foundation Trust.*

Grašič K, Mason A, Street A. 2015. Paying for the quantity and quality of hospital care: the foundations and evolution of payment policy in England. *Health Economics Review,* 5**,** 1-10.

Keogh B. 2013. *Review into the Quality of Care and Treatment Provided by 14 Hospital Trusts in England: Overview Report. www.nhs.uk/NHSEngland/bruce-keogh-review/Documents/outcomes/keogh-review-final-report.pdf*.

Lehr J. 1885. *Beiträge zur Statistik der Preise insbesondere des Geldes und des Holzes.,* Frankfurt a. M, F. D. Sauerländer Verlag.

Marshall A. 1887. Remedies for Fluctuations of General Prices. *Contemporary Review,* 51**,** 355-375.

NHS England, Care Quality Commision, Health Education England, Monitor, Public Health England, Trust Development Authority. 2014. *NHS Five Year Forward View*. London. NHS England.

OECD 2001. OECD Productivity Manual: a guide to the measurement of industry-level and aggregate productivity growth. Paris: Organisation for Economic Cooperation and Development.

Qresearch 2009. Trends in Consultations Rates in General Practice 1995-2008 Tables. NHS Information Centre for Health and Social Care.

Street A, Ward P. 2009. *NHS Input and Productivity Growth 2003/4 - 2007/8,* York, Centre for Health Economics research paper 47.

8. Appendix

In calculating productivity growth for the health care system, it is necessary to combine the multitude of outputs and inputs into single measures for both outputs and inputs. This requires the construction of an output growth index (X) and an input growth index (Z), with total factor productivity growth ΔTFP calculated by comparing growth in outputs with growth in inputs such that:

$$\Delta TFP = [X/Z] - 1 \quad (1)$$

In order to estimate total factor productivity, it is necessary to correctly define and measure the output and input indices.

8.1 Output growth

Quantification of health care output is a challenge because patients have varied health care requirements and receive very different packages of care. To address this, it is necessary to classify patients into reasonably homogenous output groupings, such as Healthcare Resource Groups (HRGs) or Reference Cost (RC) categories. Furthermore, in order to aggregate these diverse outputs into a single index, some means of assessing their relative value is required. Usually prices are used to assess value, but prices are not available for the vast majority of NHS services for which people do not have to pay at point of use. In common with the treatment of other non-market sectors of the economy in the national accounts, costs are used to indicate the value of health services. Costs reflect producer rather than consumer valuations of outputs, but have the advantage of being readily available.

As costs are not believed to truly reflect consumers' valuations, Atkinson suggests supplementing costs with information about the quality of non-market goods and services (Atkinson, 2010). One way of doing this is by adding a scalar to the output index that captures changes over time in different dimensions of quality (Castelli et al., 2007). Thus, following Castelli et al (2007), the output growth index (in its Laspeyres form) can be calculated across two time periods as:

$$X^{cq}_{(0,t)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \quad (2)$$

We define x_j as the number of patients who have output type *j*, where *j*=1…*J;* c_{jt} indicates the cost of output *j;* q_j represents a unit of quality for output *j*, and v_j is the value of this unit of quality; and *t* indicates time with 0 indicating the first period of the time series. Our measures of quality include inpatient and outpatient waiting times, survival rates following hospitalisation, and blood pressure management in primary care.

8.2 Input growth

Turning to the input growth index (Z), inputs into the health care system consist of labour, intermediate goods and capital. Growth in the use of these factors of production can be calculated directly or indirectly (OECD, 2001). A direct measure of input growth can be calculated when data on the volume and price of inputs are available. In its Laspeyres form, the input growth index can be calculated as:

$$Z^{D}_{(0,t)} = \frac{\sum_{n=1}^{N} z_{nt} \omega_{n0}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} \quad (3)$$

Where z_{nt} is the volume of input of type *n* at time *t* and ω_{nt} is the price of input type *n* at time *t*.

However, data about the volume of inputs are rarely available. It is, therefore, common practice to calculate input growth using expenditure data. Changes in expenditure are driven by both changes in the volume of resource use and in prices. Hence, to isolate the volume effect, it is necessary to wash out price changes by converting 'current' monetary values into 'constant' expenditure using a deflator π_{nt}. This deflator reflects the underlying trend in prices for the input in question, such that $\omega_{nt+1} = \pi_{nt}\omega_{nt}$.

If expenditure data and deflators are available, the input growth index can be specified as:

$$Z_{(0,t)}^{Ind} = \frac{\sum_{n=1}^{N} \pi_{nt} E_{nt}}{\sum_{n=1}^{N} E_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\pi_{nt}\omega_{nt}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\omega_{n0}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = Z_{(0,t)}^{D} \quad (4)$$

As shown, this is equivalent to using volume data, provided that deflators capture correctly the trend in prices for each input in question.

8.3 Productivity growth

The above equations show output or input growth over two periods from a base (0) to a current period (*t*). Usually, there is interest in assessing productivity growth over longer periods of time. There are two ways to do this. The first way is by means of a fixed base index, which applies the same set of output weights (c_j) and input weights (ω_j), usually that of the base year (year 0), throughout the full series. This has the advantage of using a common set of weights across all periods, allowing growth rates to be interpreted solely as changes in volumes. Use of a fixed base index is common when calculating growth rates for a specified basket of goods and services.

The drawback of this approach is that it requires the contents of the basket to remain unchanged over the full period. If this requirement cannot be met, the alternative is to use a chained index. This approach has long been recommended (Lehr, 1885, Marshall, 1887) as a way to overcome the problems arising when new commodities appear and old commodities disappear, making the use of weights of the base year practically impossible. By updating the weights in every period, it is possible to account for ongoing changes in the composition of the outputs and inputs being measured (Diewert et al., 2010).

The main advantages of using a chained index, over a fixed base index, are:

- ease of handling changes in the type of outputs produced and inputs utilised in production, as these only need to be common across two adjacent periods rather than for the full series (Balk, 2010);
- regular updates of the weights better reflect actual price and volume changes (de Boer et al., 1997);
- the difference (or spread) between the Laspeyres and Paasche formulations of the indices is lower than it would be if using a base index.

Using the Laspeyres output index as defined in eq. (2), a chained output index takes the following form:

$$X_{(0,T)}^{cq} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0}\left[\frac{v_{j0}q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0}c_{j0}} \times \frac{\sum_{j=1}^{J} x_{jt+1} c_{jt}\left[\frac{v_{jt}q_{jt+1}}{q_{jt}}\right]}{\sum_{j=1}^{J} x_{jt}c_{jt}} \times \cdots \times \frac{\sum_{j=1}^{J} x_{jT} c_{jT-1}\left[\frac{v_{jT}q_{jT}}{q_{jT-1}}\right]}{\sum_{j=1}^{J} x_{jT-1}c_{jT-1}} \quad (5)$$

This can be simplified as:

$$X^{c,q}_{(0,T)} = X^{c,q}_{(0,t)} \times X^{c,q}_{(t,t+1)} \times \cdots \times X^{c,q}_{(T-1,T)} \quad (6)$$

where each link is represented by eq. (2) for the relevant two consecutive years. An analogous construction applies to the chained input index.

8.4 Note on quality adjustment

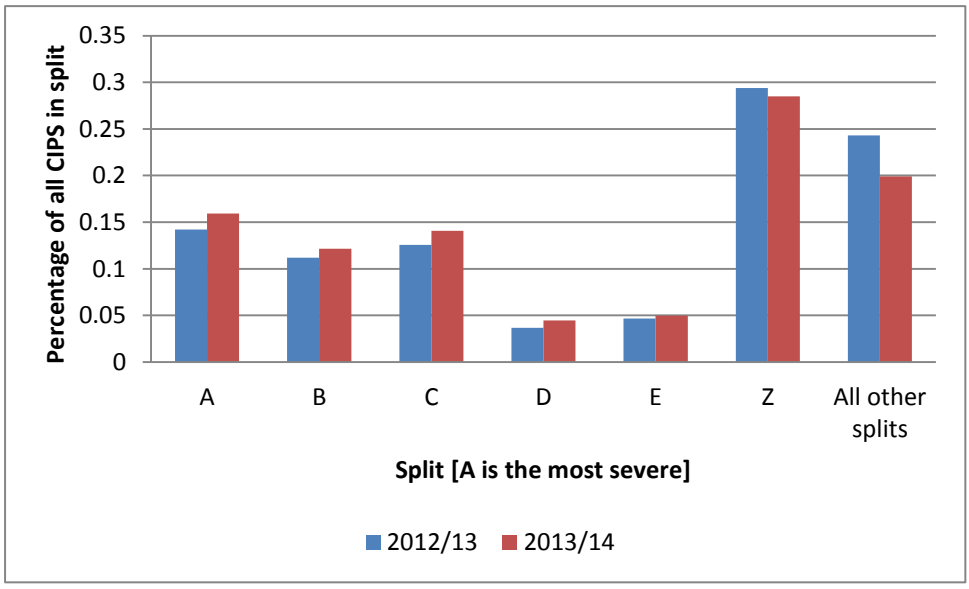
As in previous years, we find a positive contribution of quality adjustment over time, even though the average value of the quality indicators might be falling. This is mostly due to the shift of patients to more complex HRGs as well as to an ageing population.

Shift of activity

We can observe a shift of activity as an increasing number of patients is being treated in the more complicated HRGs. The last letter in a particular HRG represents the split, which then accounts for potential complications and comorbidities (CC). Splits are in alphabetical order, with A being the HRG with the most CCs. Letter Z means that no CCs present.

In Table 47 we can observe the change to more severe splits between 2012/13 and 2013/14, characterised by higher percentage of activity in splits 'A', 'B', 'C' and lower percentage of activity in other splits.

Table 47: Percentage of CIPS in HRGs with different splits



More complicated cases are correlated with lower survival rates and older population. Although quality for these patients is improving, because more severe patients are being treated, average quality appears poorer. We present an example of this in Table 48.

Table 48: Shift of activity; survival rates example for HRG EB10

HRG	#CIPS 2012/13	#CIPS 2013/14	Survival 12/13	Survival 13/14
EB10A	1,073	2,306	*71.95%*	*73.55%*
EB10B	4,267	5,485	*77.83%*	*80.75%*
EB10C	9,671	9,389	*85.13%*	*85.22%*
EB10D	17,328	13,302	*94.25%*	*95.04%*
Average survival			**88.62%**	**87.82%**

In this example, we observe a shift of activity towards more complicated cases (HRG ending with A is more complicated than B); survival rates improve in each HRG, but average survival falls.

One way to see the impact of shift of activity on quality adjustment is to calculate the average impact of each indicator using the 12/13 distribution of patients across HRGs. This can be seen in Table 49.

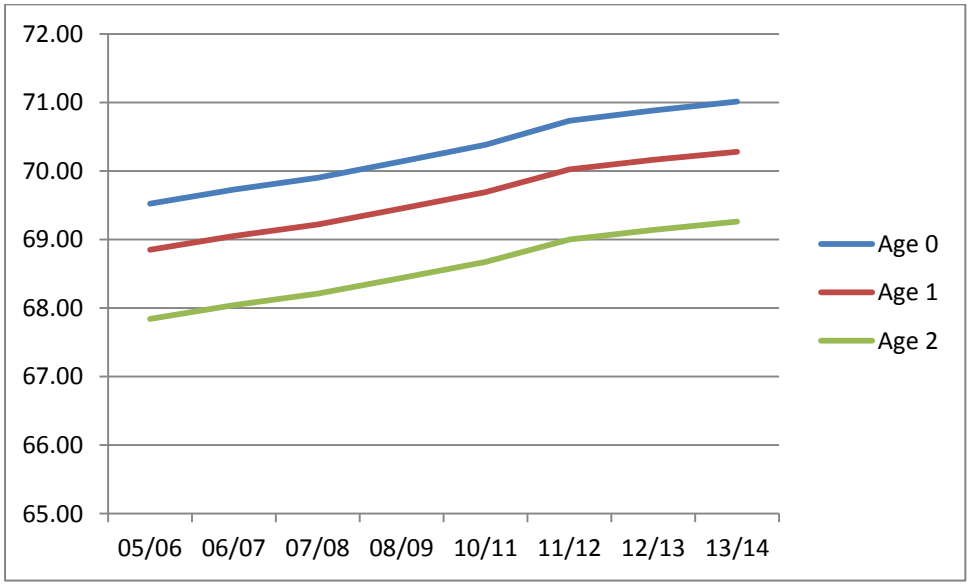
Table 49: Shift of activity: relative contribution of each of the indicators using different distributions of HRGs

	2012/13 Distribution	2013/14 Distribution
Waiting times	99.58%	100.06%
Life expectancy	100.30%	100.65%
30-day survival	99.65%	99.75%
Total	99.84%	100.15%

Ageing population

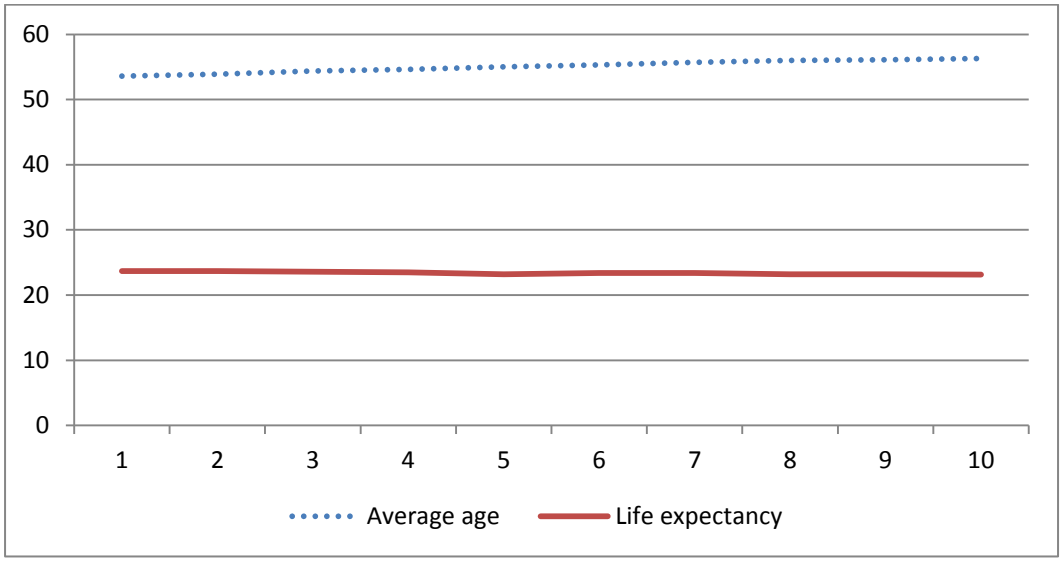
The shift of activity towards more complicated HRGs is closely linked with pressures associated with an ageing population and its influence on average life expectancy. According to the tables produced by ONS, life expectancy is increasing every year. The example in the graph shows remaining life expectancy for children aged 0, 1 and 2 over time.

Table 50: Life expectancy for children aged 0, 1 and 2



According to ONS data and as illustrated in Table 50, if the age profile stayed the same over time, we would see an increase of average life expectancy. However, this is not what our data shows. This is due to an increasing average age of population as can be seen in Table 51.

Table 51: Average age and average life expectancy



Shift of patients to more complex HRGs as well as ageing population are the reason why the overall impact of quality on the output was positive in 2013/14, despite the apparent drop in achievement level for individual quality indicators. Reported average values do not capture the quality improvement on the HRG level and we advise caution when using them for longitudinal comparison.

8.5 Trust-only productivity measures

While the main body of our text focuses on an overall NHS measure of productivity, we also produce estimates of Trust-only productivity changes, and the components thereof.

The low growth in inputs, as captured in our NHS input index, may not fully reflect the actual state of this growth: due to reorganisation of the NHS and discontinuation of PCTs, we might not be able to fully capture life-for-like inputs data. Therefore, we also calculate the inputs growth for trusts only, with the rationale being that their reporting is less affected by the changes. As shown in Table 52 the **input index is much higher when taking only trusts into account, with a mixed index suggesting growth of 3.64% and indirect index growth of 3.60%**.

Similarly, we can also produce a trusts-only output index. **When we look at the activity performed by trusts only, the quality-adjusted output index rises to 3.07%, mainly due to a large increase in reference costs activity.**

Table 52: Input, output and productivity growth, trusts only

	Input growth		Output Growth	Productivity growth	
	Mixed	Indirect		Mixed	Indirect
2012/13–2013/14	3.64%	3.60%	3.07%	-0.51%	-0.54%

Using this information we can produce trust-only productivity growth figures, estimated -0.51% (mixed measure) and -0.54% (indirect measure). These negative estimates of productivity growth for trusts are considerably lower than for the NHS as a whole.